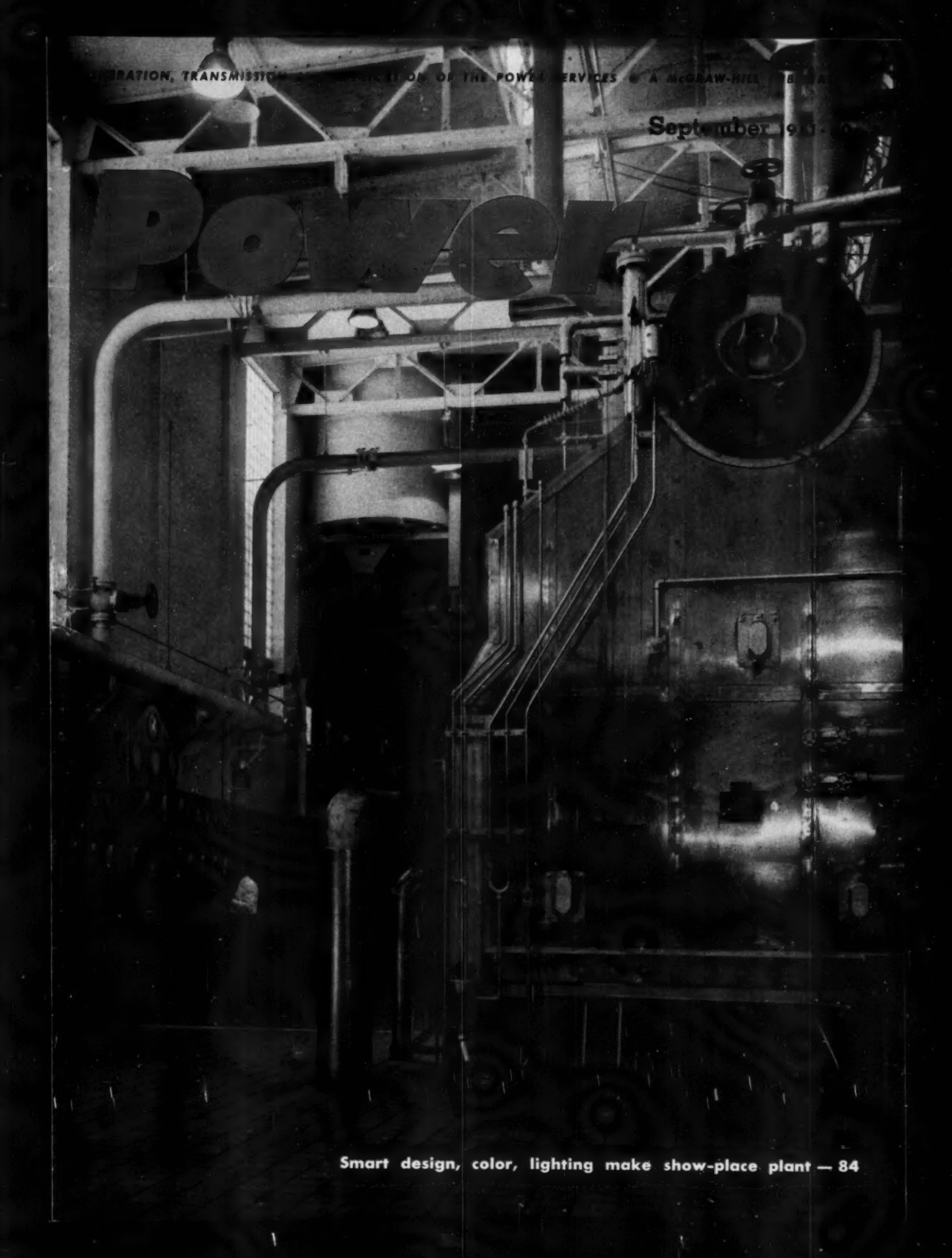
...RATION, TRANSMISSION ... DISTRIBUTION OF THE POWER ... SERVICES ● A McGRAW-HILL ... PUBLICATION

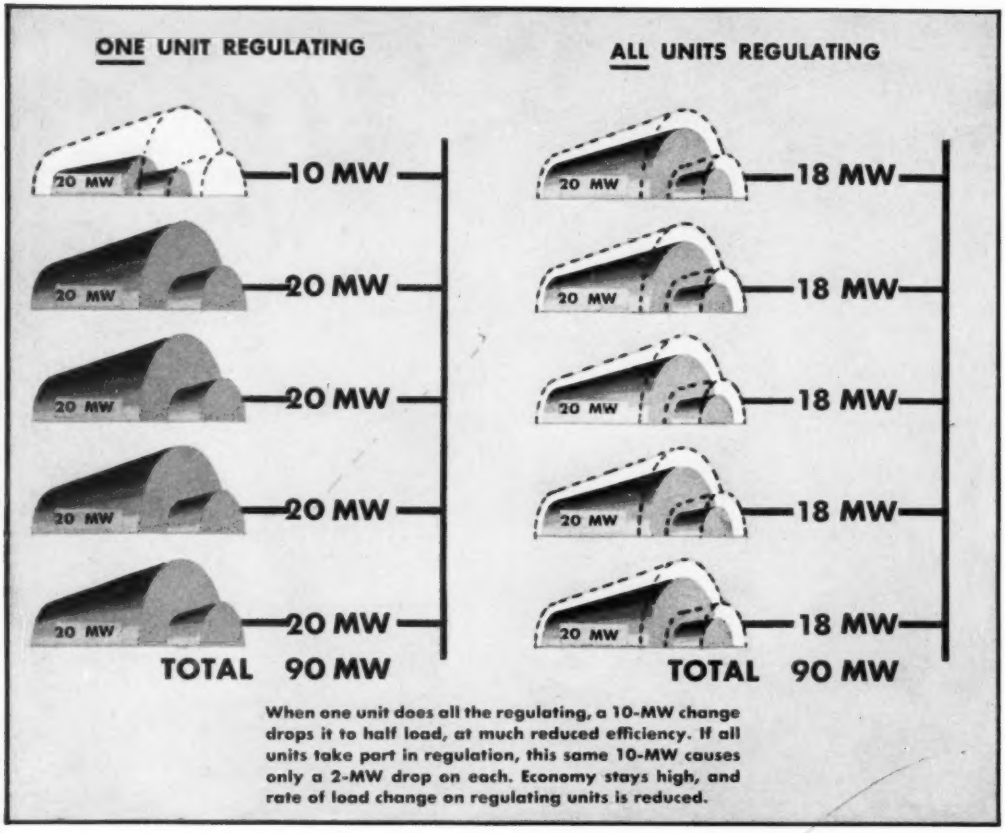
September 19...

POWER



Smart design, color, lighting make show-place plant — 84

How L&N Unit Load Control Cuts Effects of Load Changes



When one unit does all the regulating, a 10-MW change drops it to half load, at much reduced efficiency. If all units take part in regulation, this same 10-MW causes only a 2-MW drop on each. Economy stays high, and rate of load change on regulating units is reduced.

SPLIT up system load changes among as many generators as possible—and get smoother, better-scheduled loading on each unit. This trend in system control is a practical means of keeping load and generation balanced within a regulating area.

The bigger the system, and the larger its total load changes, the greater is the opportunity of using Unit Load Control to minimize the size and speed of variations felt by each unit. Ample flexibility is built into the control to allow the station operator to choose ratio of load distribution, maneuvering points, and high or low limits—as determined by the system's requirements of the moment.

If you're adding new units, plan now for tomorrow's control needs. Or if you're examining your present system with a view towards greater flexibility and closer automatic control of regulation, investigate the possibilities of applying Unit Load Control to present capacity. An L&N engineer will be glad to work with you on your problem, or to send a copy of our catalog. Write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

Jrl. Ad ND4-56-451(3)

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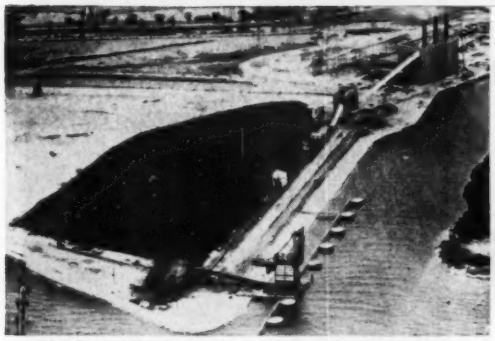
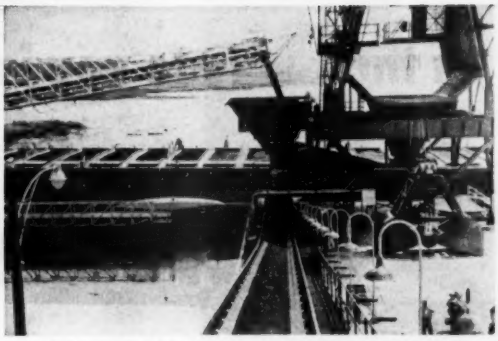
LINK-BELT engineering experience...

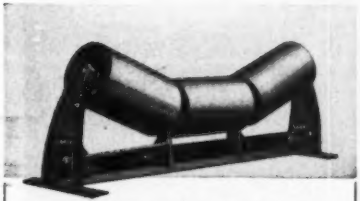


Link-Belt supplied this power plant with complete belt conveyor system for unloading, storing and reclaiming coal.



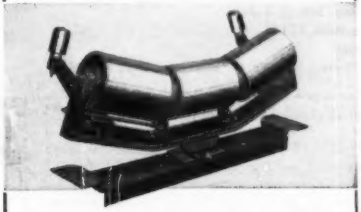
Receiving end of belt conveyor system, showing boat self-unloading coal into hopper. Another hopper and feeder handle barge coal.

Plus LINK-BELT quality components...



SERIES 100 TROUGHED BELT IDLERS. Strong, balanced integral rolls revolve on high-grade roller bearings, Grease-in, dirt-out seal, large reservoir preserve lubricant.

RUBBER-TREAD IMPACT IDLER for loading points protects the belt by absorbing the shock of heavy materials or lumps delivered from above.



BELT-TRAINING IDLER for automatic belt positioning. The actuating rolls respond to slightest contact — quickly recede and center the belt to minimize wear.

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WHAT'S your materials handling problem? Tonnage, distance or a combination of the two? Heavy or light materials? Large lumps or fines? Continuous or intermittent operation?

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And Link-Belt will build your supporting structures and enclosures . . . install the job completely. One source — one responsibility. Every detail receives the proper attention to assure you an efficient, trouble-free, long-life conveying system.

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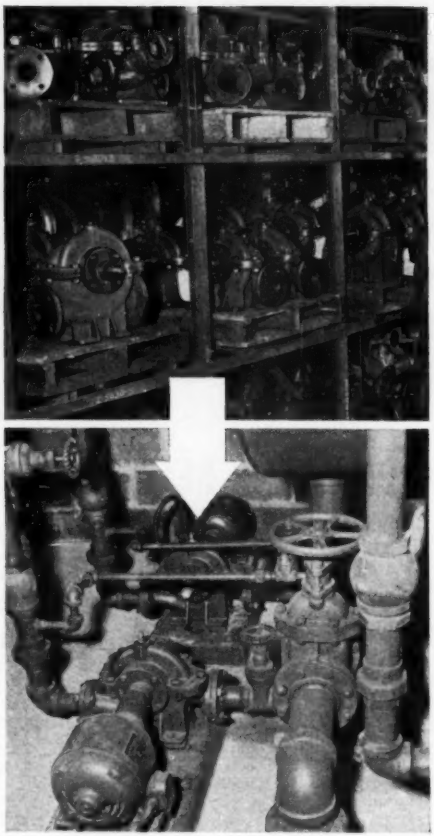

From our shelf to your plant in two weeks! That's how fast you can get a standard centrifugal De Laval pump. We now have on hand GS pumps, motors and bedplates in sizes 2½", 3" and 4" ready for assembly and shipment. Capacities to 280 gpm, heads to 75 ft, at 1750 rpm. • Also available for immediate delivery are bare pumps in the same sizes with capacities to 400 gpm, heads to 230 ft, at 3500 rpm. We can assemble and ship these units within two weeks after receipt of the motor. • Want complete details quickly? Simply telephone or fill in the coupon and mail today.

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Power

SEPTEMBER 1951 VOLUME 95 NO. 9

combined with Operating ENGINEER

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(Member ABC and ABP)

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own index annually, copies of which are available on request to the editorial offices.

SHOW-PLACE PLANT is a phrase that applies literally to General Electric Co's modernized Nela Park facilities. The boiler room pictured on our cover does double-duty as a demonstration area for high-bay lighting. It shows, as well, how streamlined modern equipment, painted with today's knowledge of color values, and arranged with skill, can turn the gloomy, dungeon-like boiler rooms of the past into bright, cheerful places where efficiency comes naturally.

You'll want to put some of this up-to-the-minute thinking to work in your plant, so take a tour with us through Nela Park's setup by way of the picture story beginning on p 84. Then hold onto it as a scrapbook of layout, color and lighting ideas.

Next month . . .

■ October brings a 16-pg special section on fans. Practical dope on: how fans work, construction, arrangements, characteristics and control methods. Also on fan figuring, air-conditioning and mechanical-draft applications, maintenance. Watch for it!

■ Ed Kates will be back with first of two articles on alarm and shutdown systems for diesel plants.

■ Been wondering how defense mobilization affects you—where you stand on equipment purchases, fuel, repair parts, etc? We're going to try to pierce the Washington fog by way of a new department. Defense Digest, it will be called, and each month it'll bring you clear and timely interpretations of what defense regulations mean to you and your job.

■ One big job in all industry today is maintenance of motor controls. For live pointers on best ways to do the work, see October's PO&M section.

. . . and future months

■ Sheppard Powell will do another of his roundups on water treatment equipment—this time on that widely used device, the water softener.

■ Even for the practicing designer of piping, figuring bends isn't easy. New charts for common bends do most of the work, should be welcome.

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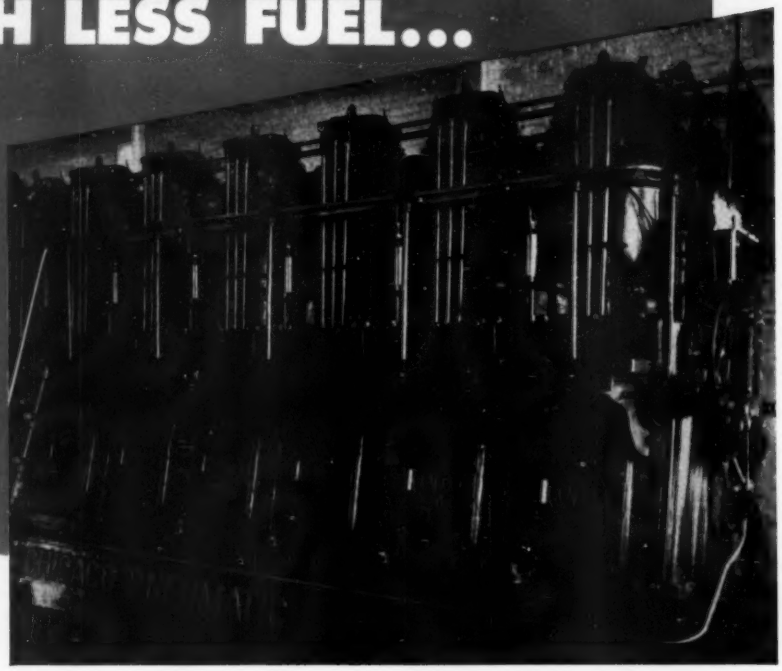
...so COSTS COME DOWN when you use Texaco Ursa Oil



Whether you're using Diesel, gas or dual-fuel engines, you'll get better compression and combustion—with resulting lower fuel consumption—by lubricating with *Texaco Ursa Oil.* That's because rings stay free, ports stay clear, valves function properly.

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...with Power readers...

GRASS ROOTS STORY . . .

It was with considerable reminiscing that I read the editorial announcing the retirement of Fred Annett.

Since 1922 I have been familiar with the educational and practical value of this editor's writings . . . his efforts in placing before his readers a real grass roots story of applied engineering.

His basic thoughts are on a par with those Terrell Croft left in the electrical field and both fitted the philo ophy of that Grand Old Man of POWER, *Fred Low.*

I, for one, do hope that his retirement from more active duty gives Annett the time to revise his books and add to that practical source of engineering wisdom. Most of us get a sense of security from such information in our personal libraries.

Richmond, Va. — MARTIN G LANE

MEDAL TO BOYER

The 1951 Lamme Medal, one of Ohio State University's highest honors, went to POWER author and reader, Ralph L Boyer, vice-president and chief engineer of The Cooper-Bessemer Corp. A faculty committee of the College of Engineering chose Boyer, 24th OSU man so honored from over 10,000 graduates since 1892, for his contributions to the development of gas-diesel and high-compression spark-ignited engines.

(*Continued on page 218*)

...lines and bylines

ROCKY MOUNTAIN engineering circles know Bob Throne well, for with the exception of a short hitch in a foreign land—Texas—he's made his career in Colorado. That Texas hitch came shortly after he'd started on Denver Gas & Electric's junior-engineer training course in 1917, carrying a fresh Oregon State degree. He put in 7 months in the big state—as instructor, Ground School in Aeronautics, University of Texas.

Robert F Throne

Back in Colorado, he took on a variety of power-plant operating assignments—results engineer, asst chief engineer and chief engineer—becoming staff mechanical engineer in 1925.

In 1928, Throne took over as supt, steam production dept, responsible for construction, operation and maintenance of electric plant. See p 86 for some results of his experience.

"Torchy" Elonka

"Greasy" O'Connor

The Old Red Schoolhouse Was Never Like This . . .

. . . says Associate Editor Steve Elonka after two weeks wrestling with a welding torch at Eutectic Welding Institute. Always a believer in learning by doing, skilled-machinist Steve wanted to round out his already broad maintenance know-how by getting the lowdown on low-temperature (eutectic) welding. He's back now, busting at the seams with practical dope on welding, brazing, hard overlaying.

Other POWER editors have been soaking up "larnin" too—as a matter of fact there was a spell this summer when it seemed like we had more editors at school than on the job*. Ben Skrotzki, for one, was cerebrating with the professors at the school for thermodynamics teachers sponsored by ASEE, ASME at Michigan State College. He says this refresher put him in fighting trim for the study course in practical heat power he's readying for POWER's pages.

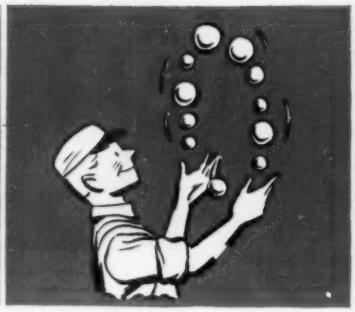
Like Ben, Jim O'Connor had an ulterior motive for doing some postgraduate work. Jim's deep in plans for our December special section on *Bearings and Lubrication*, couldn't afford to miss a special course put on at MIT. Two weeks of lectures and afterhours bull sessions not only gave him the latest slants of the experts but a good idea of what industry's lube men want to know.

Plushiest assignment went to Joe McCabe—a corrosion engineering seminar at International Nickel Co's Harbor Island Testing Station. Between bouts with the corrosion specialists, Joe had time for swimming and fishing. (He didn't catch much.—*Ed.*)

**Such schooling is really part—an important part—of our job of keeping you informed of the latest and best in ideas and methods.*

LINE UP for low-cost steam...
with the B&W Type E Pulverizer

Five B&W Type E Pulverizers, serving a B&W Radiant Boiler of 800,000 lb. per hr. steam capacity.



RECIRCULATING LOAD— DRIES AS IT GRINDS

Recirculation of fines within the mill gives repeated, quick-drying contact with large masses of heated air and metal... produces proper fineness at all loads, even with coal as wet as it can get. Fines are classified in the mill.

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Balls and grinding rings wear together... assure uniform fineness regardless of attrition of the grinding elements . . . fineness automatically increases at reduced loads.

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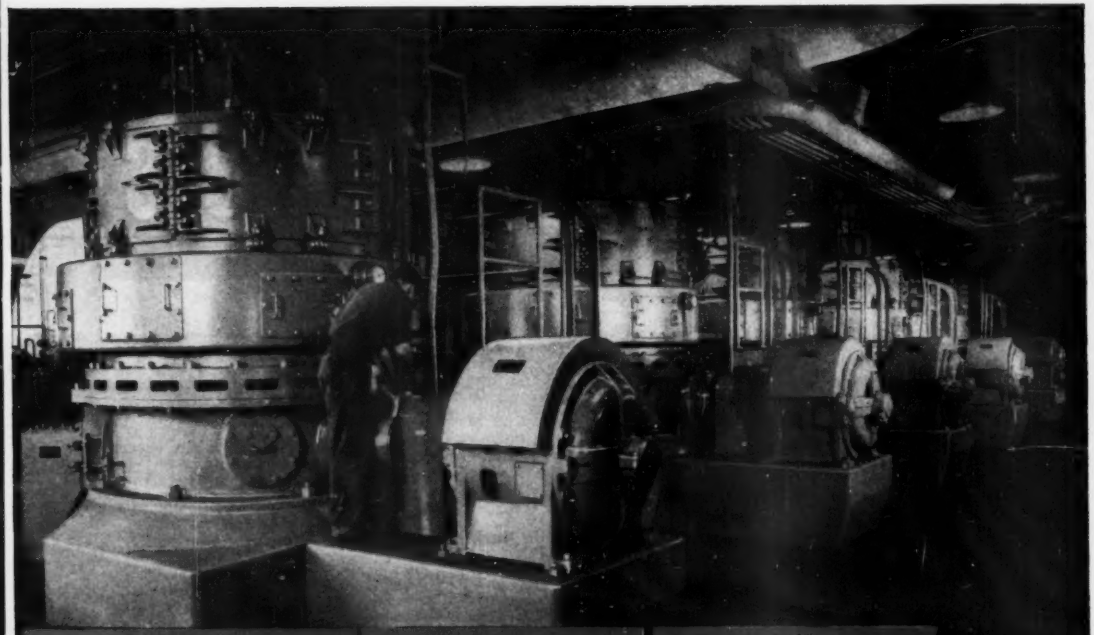
Unique in pressurized operation, the Type E Pulverizer requires remarkably little maintenance of the primary fan, because it blows only clean air . . . is not subject to the damaging abrasion of entrained particles.

New Bulletin G-57 illustrates and describes the design, construction, operating and maintenance features of the Type E Pulverizer. Write: The Babcock & Wilcox Company, 85 Liberty Street, New York 6, New York.



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Like the accelerator on your automobile . . . assures proper coal-to-air mixture . . . produces desired rate of steam generation over a wide range with coal conditions suitable for sustained high combustion efficiency.

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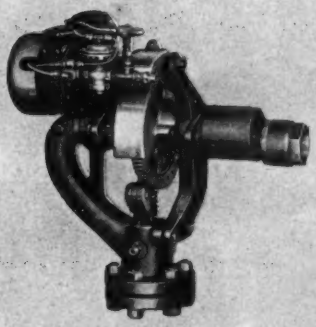
DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

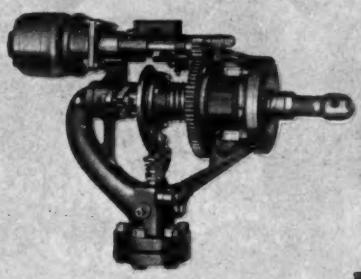
DIAMOND Model IK Long Retracting Soot Blower with mechanically operated valve. Air motor operated unit shown; also available electric motor operated.

There is a DIAMOND Soot Blower

meet the challenge of

HIGH BOILER AVAILABILITY

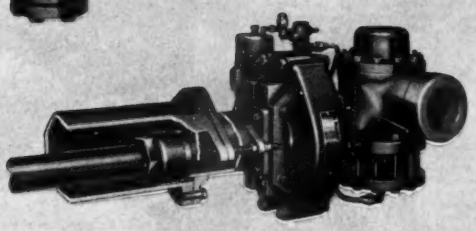


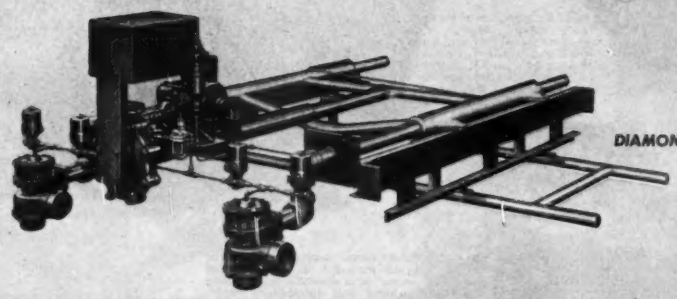


DIAMOND Model 1S Short Retracting Soot Blower. Electric operation shown; also available for manual or air operation.

DIAMOND Model G9B Soot Blower. Air operation shown; also available for manual or electric operation.

DIAMOND Model A2E Automatic Air Puff Soot Blower.





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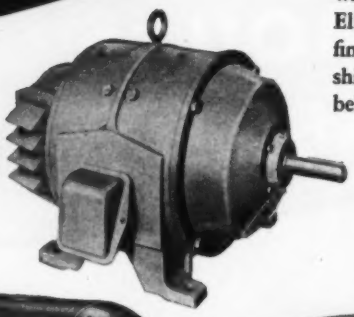
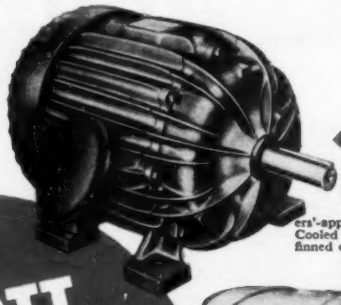
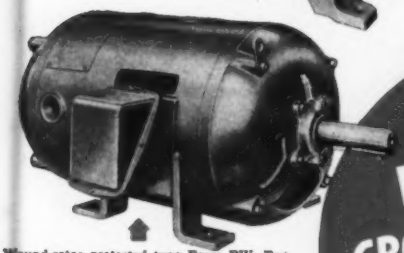
Looking for a dependable motor in any standard type, 1 hp or larger? You'll find it in this complete line, with the backing of the Crocker-Wheeler name plus the Elliott name—double assurance that you're getting as fine a motor as skilled engineering and veteran workmanship can turn out... Some representative types shown below. Write for bulletins.



DC dripproof and drip-proof-protected types Form F, in ratings to 7½ hp. Form H, 10 to 200 hp.

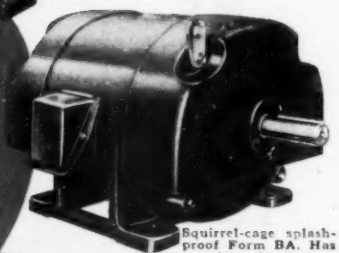


"Sealedpower" totally-enclosed fan-cooled squirrel-cage motors, 3 to 125 hp. Also explosion-proof underwriters'-approved, 20 to 125 hp. Cooled by air blown along the finned outer case.

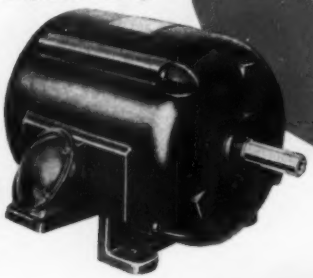


Wound-rotor protected type Form BW. For slow, smooth acceleration, high starting torque with low starting current, or variable speed. Drip-proof, splash-proof, 1 to 200 hp.

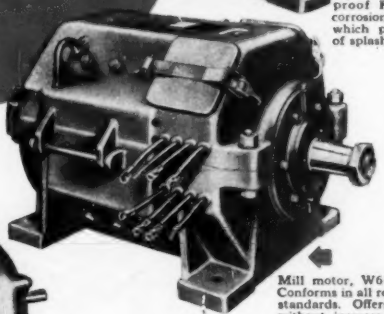
ELLIOTT
CROCKER-WHEELER
Integral
motors



Squirrel-cage splash-proof Form BA. Has corrosion-resistant covers which prevent entrance of splashing liquids.

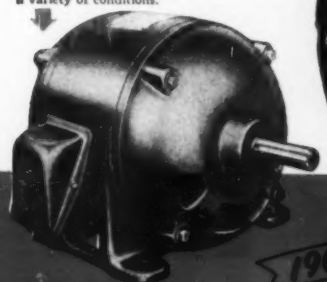


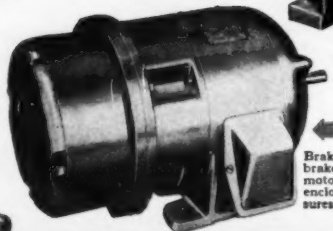
Squirrel-cage, totally-enclosed, non-ventilated Form BE. Available up to and including 3 hp at 1800 rpm, for applications requiring protection against dust, fumes, moisture.



Mill motor, W600 Series, DC. Conforms in all respects to AISE standards. Offers more power without increase in frame size.

Squirrel-cage protected type Form BA. An open dripproof motor for general purpose use. Available in wide modifications to meet a variety of conditions.





Brake motor using latest disk type brake mounted on BA dripproof motor. Also available with totally enclosed and splashproof enclosures for AC or DC applications.

HALF CENTURY OF 1901 E 1951 POWER PROGRESS

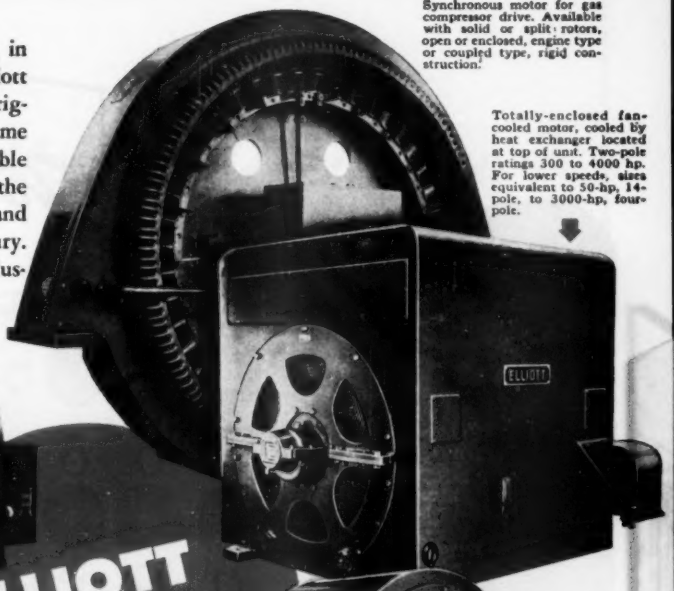
ELLIOTT

Crocker-Wheeler Division—Ampere, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

ahead with ELLIOTT

Looking for a really big motor—big in quality as well as capacity? These fine Elliott motors have the exceptional strength and rigidity of welded steel construction in frame and spider with a number of other notable advantages. Fabri-steel construction marks the greatest advance in large motor design and construction since the turn of the century. Some of these outstanding motors are illustrated below. Bulletins for the asking.

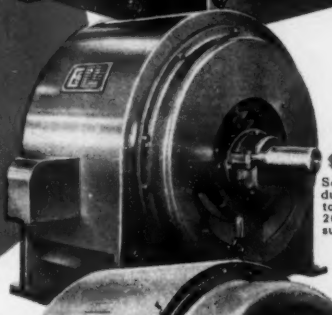


Synchronous motor for gas compressor drive. Available with solid or split-rotors, open or enclosed, engine type or coupled type, rigid construction.

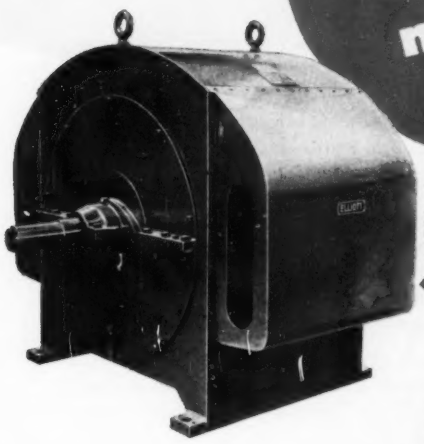
Totally-enclosed fan-cooled motor, cooled by heat exchanger located at top of unit. Two-pole ratings 300 to 4000 hp. For lower speeds, sizes equivalent to 50-hp, 14-pole, to 3000-hp, four-pole.

Large two-pole squirrel cage induction motor (350 hp up). A long forward step in two-pole design. Typical Elliott welded steel construction enables widest variation in type of enclosure.

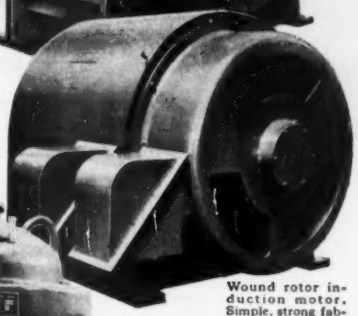
ELLIOTT large motors



Squirrel-cage induction motor, four to 14 poles, 150 to 2000 hp. All enclosure types.



Outdoor splashproof squirrel-cage induction motor especially designed for outdoor installation without protective covering. 150 hp, 14 pole to 2000 hp, four-pole. 300 hp to 1000 hp two-pole.



Wound rotor induction motor. Simple, strong fabricated construction, sleeve or anti-friction bearings. Available in all types of enclosure.

Vertical outdoor splashproof squirrel-cage induction motor. Can also be made in open dripproof or indoor splashproof with minor changes in ventilating baffles.

COMPANY

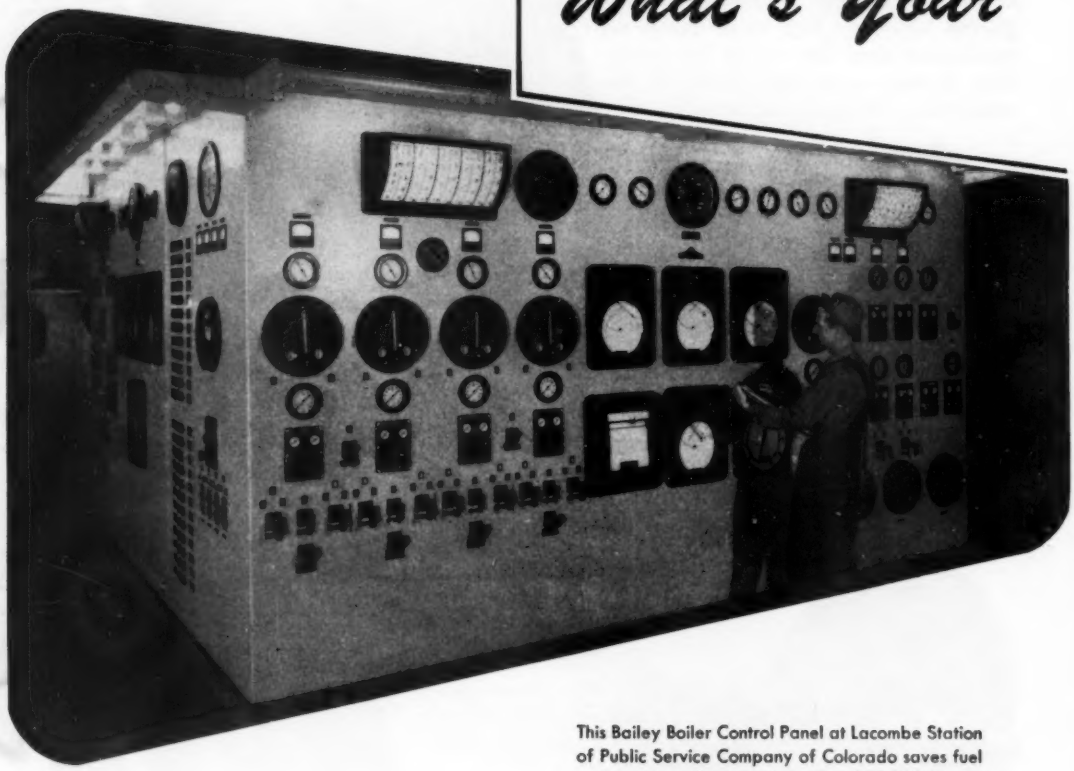
DEPT. EB

Ridgway Division—Ridgway, Pa.

DISTRICT OFFICES IN PRINCIPAL CITIES

L-809

What's Your



This Bailey Boiler Control Panel at Lacombe Station of Public Service Company of Colorado saves fuel and insures safe operation of a 350,000 lb per hr 850 psi, 900 F boiler fired by pulverized Colorado Lignite Coal and/or natural gas.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Control-Dollar Efficiency ?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you. Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better control-dollar efficiency—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

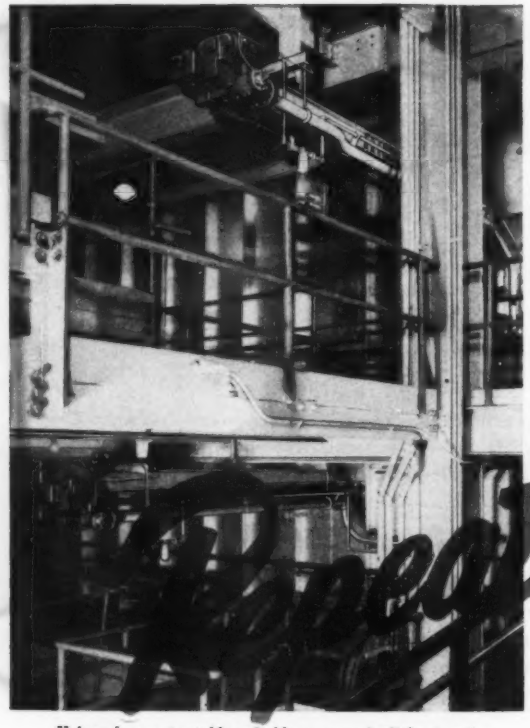
A-112-2

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

It's VULCAN at RUSSELL STATION

of Rochester Gas & Electric Corporation



Vulcan long retractable soot blowers are built for travels up to 25 feet. They can blow with either steam or air without change in the equipment. Here are two of the four in service on Unit 1 at Russell Station.

For Automatic-Sequential Soot Blower Operation

20 pneumatic Vulcans—also using air for blowing—are combined in the automatic-sequential soot blowing system for Unit 1 at Russell Station of Rochester Gas & Electric Corporation, Rochester, New York.

The system includes eight waterwall de-slaggers, six rotary units, four long retractables and two air heater cleaners.

It takes no more effort than pushing a

One of the eight Vulcan waterwall de-slaggers installed on Unit 1. Like all other Vulcans on this unit, it blows with air compressed to 500 psig, and reduced to 275 psig.

VULCAN Automatic

The boiler for Unit 1 at Russell Station was designed and built by Combustion Engineering-Superheater, Inc. Fired with pulverized coal, it is rated at 400,000 pounds per hour, with steam at 1300 psig and 955 degrees F. The C-E reheat boiler for Unit 2 has a capacity of 430,000 pounds per hour at 1500 psig and 1000 degrees F.

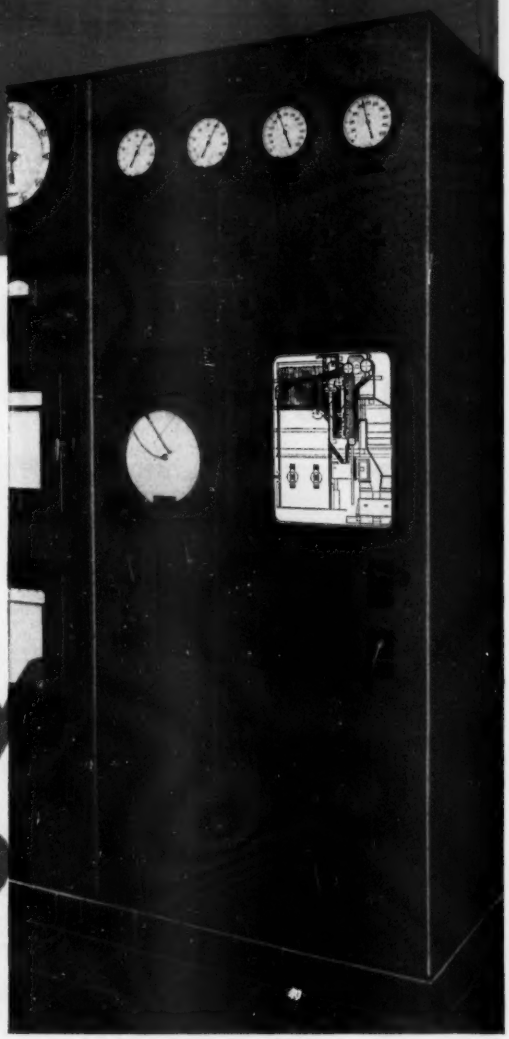
single button at the central control panel to start the automatic sequence. This saves time and labor.

Furthermore, each boiler section is effectively cleaned, and at the proper intervals. Soot and slag do not accumulate to decrease operating efficiency.

Unit 2—soon to be in operation at Russell Station—will also have a Vulcan Automatic-Sequential System.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA

Each of the six VULcomatic Rotary Soot Blowers on Unit 1 is designed to give effective cleaning over a maximum area, and to operate with a minimum of care, attention and maintenance.

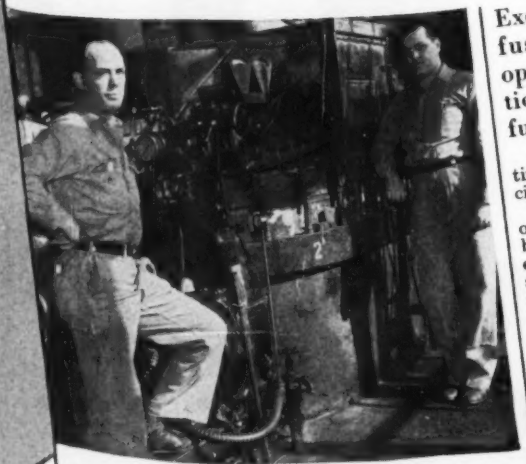


At the panel, operators know from lights on the boiler diagram that each blower is operated in proper sequence. They can interrupt the automatic sequence at will, and go to individual blower control with push button.

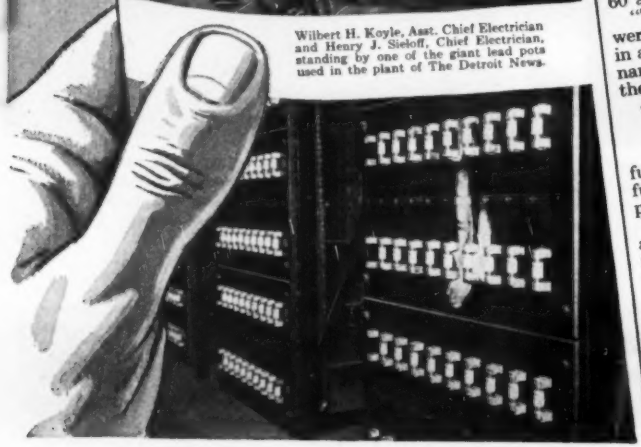
The Detroit News

WSPAPER FOR MORE THAN 77 YEARS
ree Weekday and Sunday, of Any Michigan Newspaper

FUSE FAILURES ON LEAD POT CIRCUITS STOPPED COLD — BY CHANGING TO FUSETRON FUSES



Wilbert H. Koyle, Asst. Chief Electrician and Henry J. Sieloff, Chief Electrician, standing by one of the giant lead pots used in the plant of The Detroit News.



Excessive heating of ordinary fuses caused 3 to 4 fuses to open every week. Cooler operation of Fusetron dual-element fuses cured trouble completely

"Prior to May 20, 1950, we had a bad time keeping all the electric heating circuits on our lead pots in full operation.

"We have two eight-ton lead pots and one six-ton. Each is electrically heated by single phase, 220 volt, 10 kilowatt elements, fed from a 220 volt, 3 phase source. The circuits on each are protected by sixty 60 ampere and nine 400 ampere, 250 volt fuses.

FOUND 6 TO 8 FUSES BLOWN

"To be sure that all heating elements were operating properly, we used to check all 207 fuses about once in two weeks. Generally our maintenance electrician would find six to eight of the 60 ampere fuses open.

"This meant that our melting pots were not operating at full efficiency and in addition to this loss, our fuse maintenance and purchases were greater than they should be.

WITH FUSETRON FUSES NOT ONE OUTAGE

"As an experiment, we changed all fuses over to FUSETRON dual-element fuses of the same amperages as had been previously used.

"To date, March 9, 1951, or after about nine months of using Fusetron fuses, our records show that not one of them has failed.

"We attribute this remarkable result to the lower resistance of Fusetron fuses which allows them to operate at a cooler temperature than other fuses that we have used."

Henry Sieloff, Chief Electrician
The Detroit News, Detroit, Mich.

Fuses that Protect in 10 Ways now Available

Fusetron dual-element fuses offer user surprising advantages

1. *Protect against short circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexspensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

Details on the Fusetron dual-element Fuse

A fuse link combined with a thermal cut-out — the result, a fuse with tremendous time-lag and much less electrical resistance.

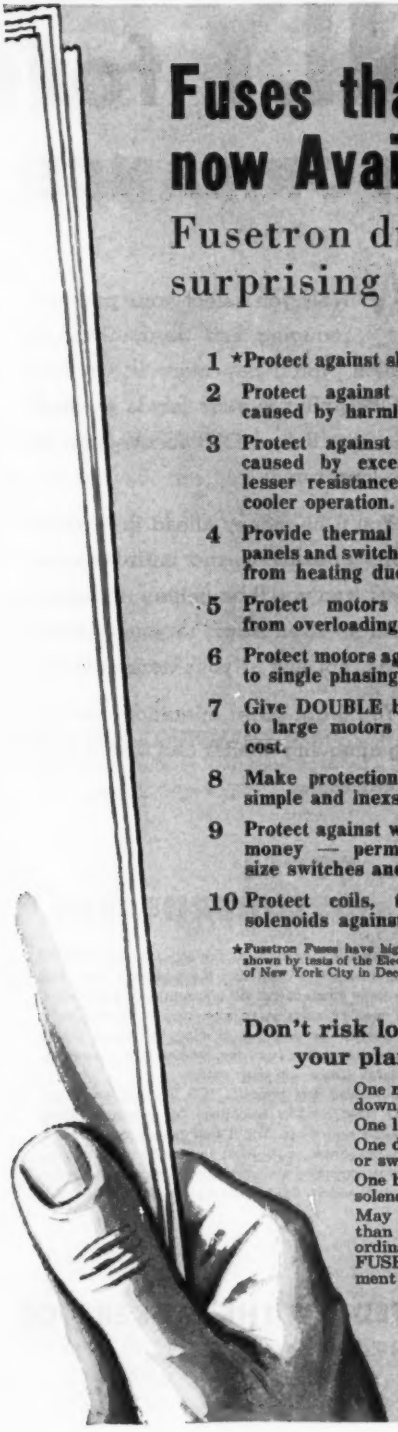
They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to same dimensions as ordinary fuses, FUSETRON Fuses fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Fusetron is a trade mark of Bussmann Mfg. Co.,



Don't risk losses in your plant!

One **needless** shut-down,
One **lost** motor,
One **destroyed** panel or switch,
One **burned out** solenoid . . .
May cost you more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

Bussmann Mfg. Co.,
University at Jefferson, St. Louis 7, Mo.
(Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

Name.....

Title.....

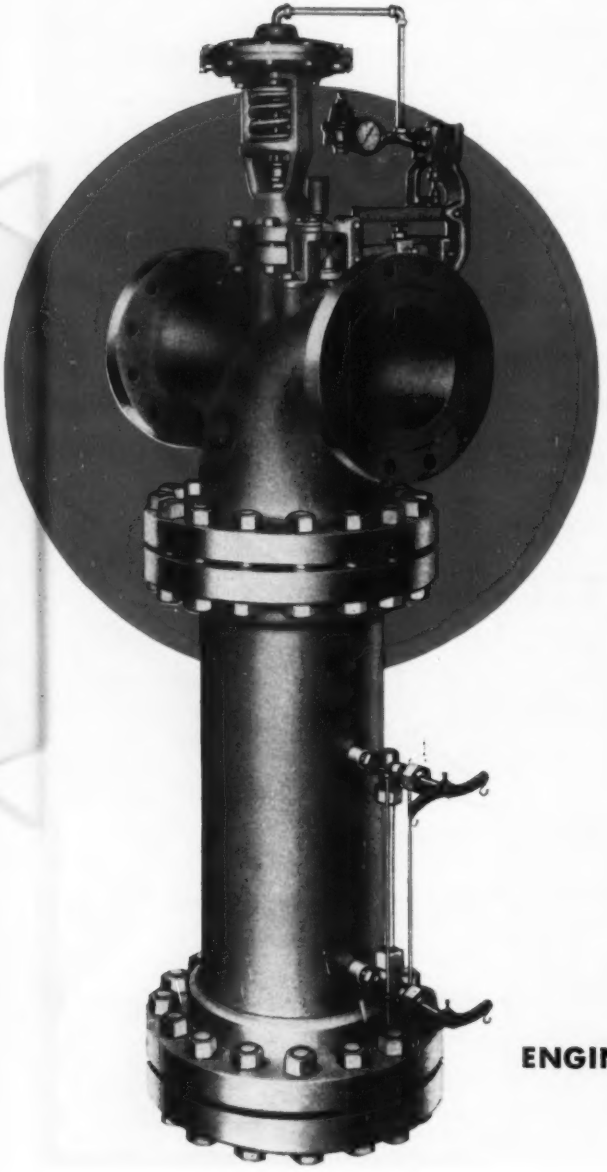
Company.....

Address.....

City.....State.....951

Designed ONLY for

BUILT FOR PERFORMANCE



WHEN you select your pressure reducing and desuperheating station, you'll pay more if you buy COPES. But if your job is a tough one, you'll find COPES cheapest in the long run.

You'll be money ahead in installation, operation and maintenance costs, and you'll be getting *accurate* control—even down to your lightest loads, not just at your normal flows.

You'll get *quiet* operation—avoiding annoying chatter and destructive vibration.

The COPES DESUPERHEATER

You'll find it easy to install the self-contained COPES Desuperheater. It goes into the line as a unit, with only three connections. All accessories are furnished. You need no extra steam atomizing valve with extra stop valves—no long run of alloy-steel steam piping—no extra piping from the temperature element to the spray nozzle—no other extras.

You'll also find your COPES Desuperheater correctly sized for low velocities—for minimum noise, vibration and wear. You'll find temperature control accurate—even on lightest flows—because cooling water is controlled and completely atomized inside the mixing chamber. Adjustment is simple and permanent.

ENGINEEREED BY THE MAKERS OF

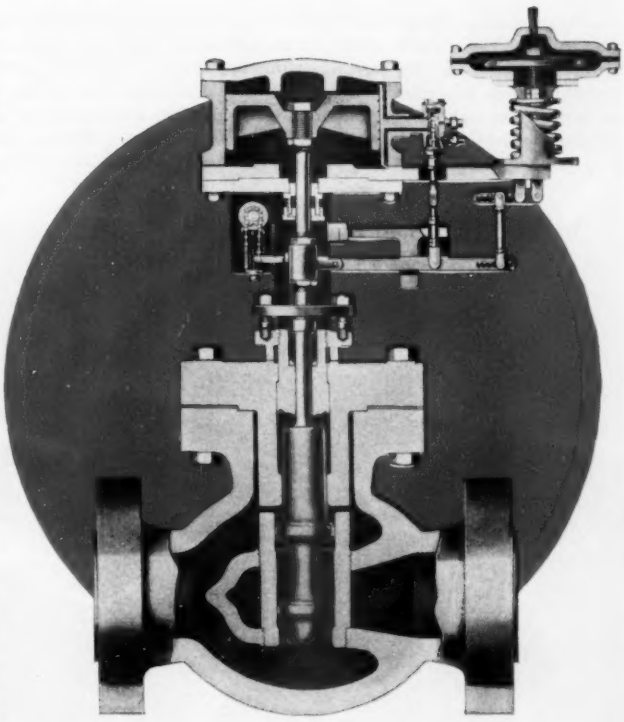
the TOUGH JOBS

NOT DOWN TO A PRICE!

You'll get 'round-the-clock dependability for years to come—with any adjustments or maintenance easily handled by your plant personnel.

It all adds up to the kind of performance you need for your tough jobs—results you cannot expect if you buy on price.

NORTHERN EQUIPMENT DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
911 GROVE DRIVE, ERIE, PENNA.



The COPES REDUCING VALVE

You'll find your COPES valve ports accurately designed for the correct capacities under the flow and pressure conditions you specify. You'll have no "hunting" to upset the precision of your control.

You'll find extra-heavy construction throughout. The valve piston is supported and guided in the areas subject to greatest velocities and forces. If these forces could cause excessive erosion, Stellite is welded to all contact surfaces before they are precision-ground to correct clearance for your installation. You'll find design and construction minimizes the possibility of sticking, leaking or vibrating. You'll suffer no objectionable noise.

COPES

FEED WATER REGULATORS

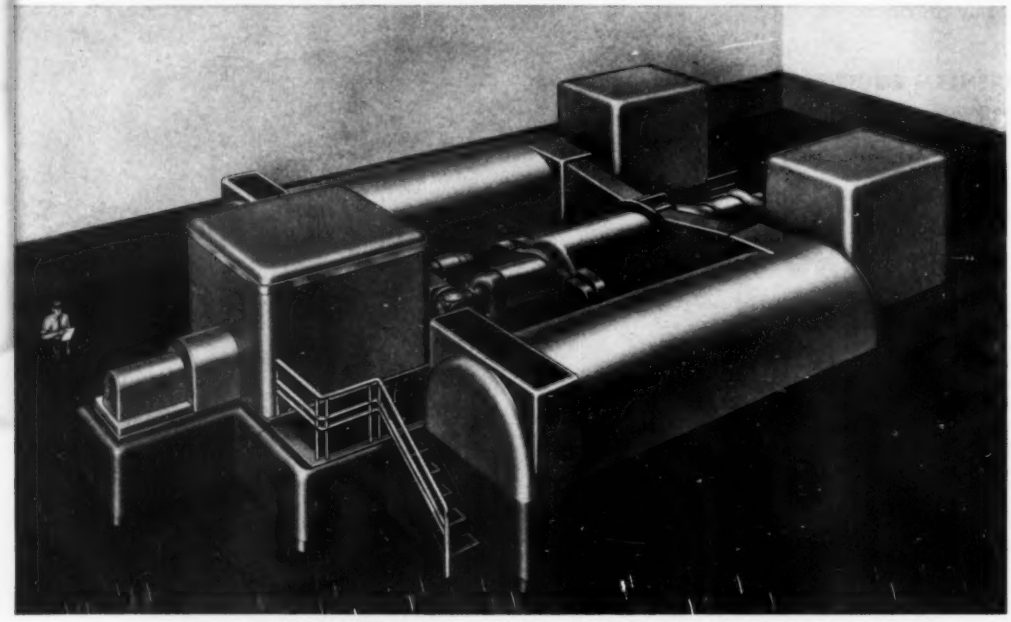
NEW WAY TO HANDLE DEMAND

Power companies, compelled to meet sudden new load demands from defense industries in outlying territories, may find the answer to their problem in the simplicity of General Electric gas turbines. Gas turbines, though they stand on their own feet as far as economy of power generation is concerned, also offer unique advantages for service in end-of-the-line plants.

For example, a gas turbine is easily and quickly installed. There's no massive foundation to worry about, and the building which houses the unit can be of the simplest construction. Furthermore, a gas turbine-generator is easy to operate—it offers the excellent possibility of modification for remote operation in the future. If load demands change, the design of the gas turbine makes moving to a new location a practical, inexpensive operation.

Several utilities, recognizing these distinctive gas turbine advantages, have ordered units to firm up service in outlying territories. If you have a similar problem, why not investigate this possibility yourself? A General Electric turbine specialist in your nearby sales office will discuss the application in the light of your requirement. And, if you'd like a copy of our 28-page bulletin describing gas turbines, write to General Electric Company, Schenectady 5, N. Y., for GEA-5516, "Gas Turbine Power Plants."

GAS TURBINES

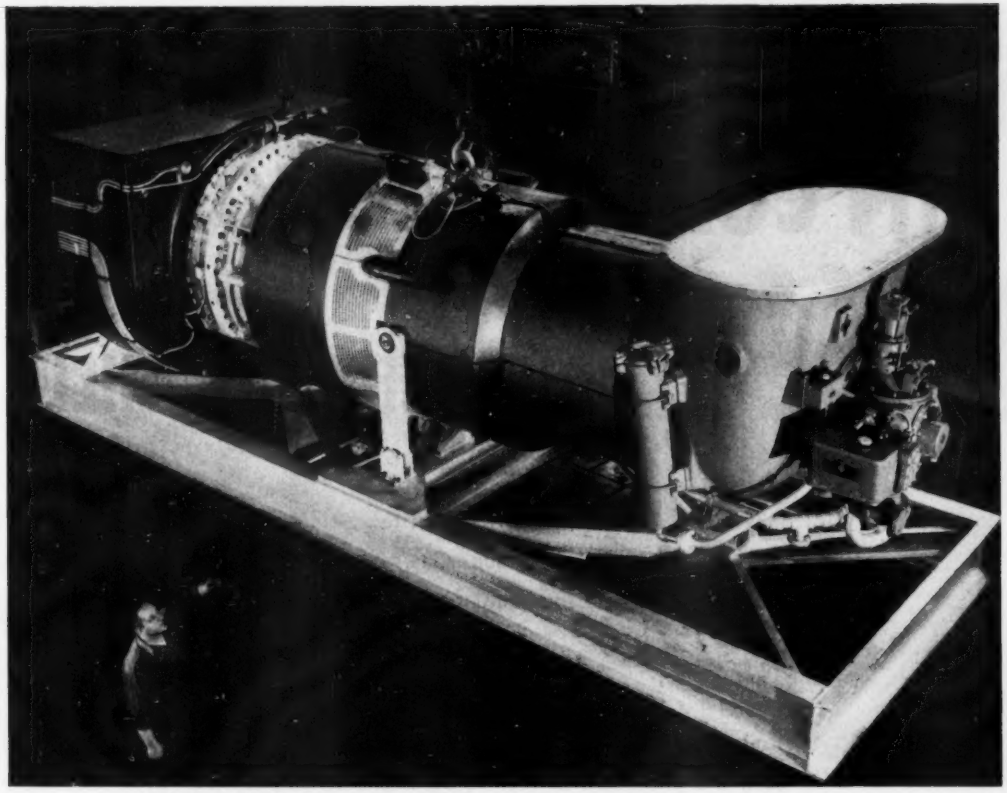


A COMPLETE POWER PLANT is yours with the compound-cycle gas turbine illustrated here. It is delivered with regenerator and intercooler and requires a minimum amount of cooling water.

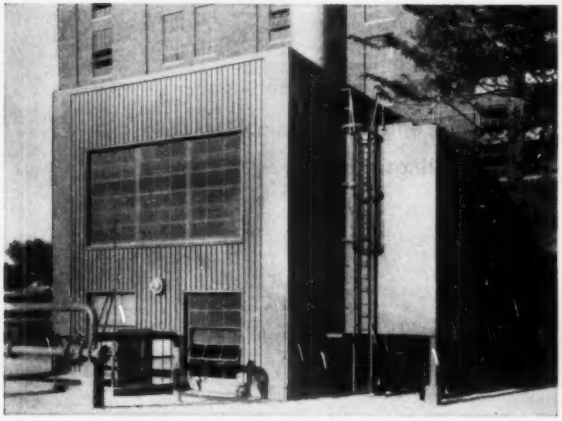
GENERAL ELECTRIC

255-4

AT THE END OF THE LINE



EASY INSTALLATION is possible because of the compact design and relative light weight of the gas turbine. The components of the simple-cycle unit can be easily handled for inspection and assembly purposes.



THE SIMPLE BUILDING AND FOUNDATION required for a gas turbine installation makes possible substantial savings in initial cost for end-of-the-line plants. In this building, the gas turbine rests on a reinforced concrete slab.

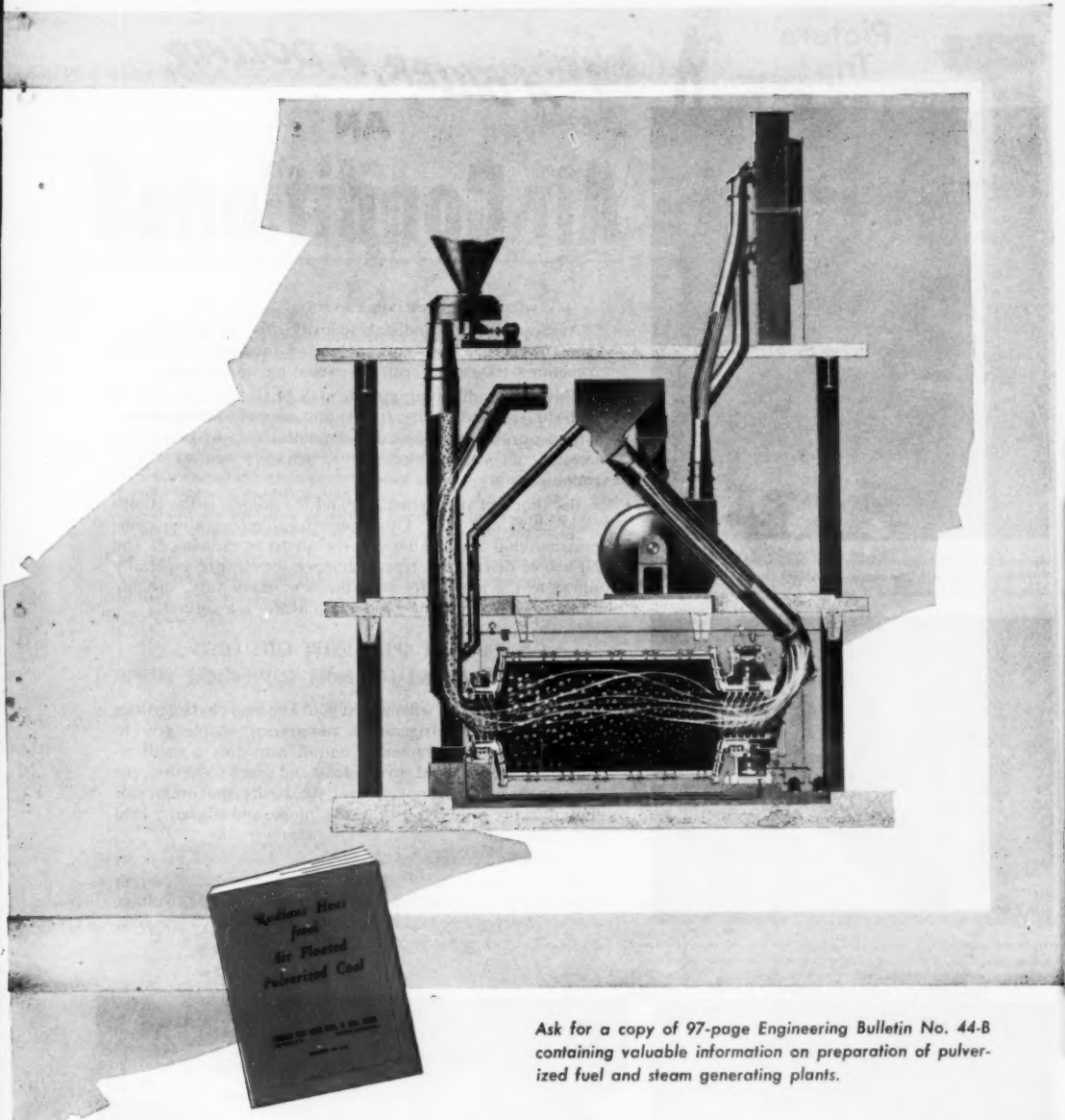
EASE OF OPERATION is a big factor in end-of-the-line plants. The control unit shown here contains all instrumentation and control equipment for operation of the turbine.

MAXIMUM FLEXIBILITY IN COAL SELECTION with KVS AIR SWEPT TUBE MILLS

Any coal . . . bituminous or anthracite . . . in any quantity, can be prepared as superfine fuel, ready for delivery to the combustion chamber.

This ability to pulverize any coal and convert it to what in effect is a highly combustible gas, means that no limitations are imposed in selecting the coal which will assure the maximum in fuel value and the minimum in steam costs.

All other components of KVS Steam Generating Units are engineered to meet specific operating conditions on available fuels for high operating efficiency and a maximum of economy at all boiler ratings.



Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

Kennedy-Van Saun
MANUFACTURING AND ENGINEERING CORPORATION
2 PARK AVENUE • NEW YORK 16, N. Y.
FACTORIES: DANVILLE, PA.
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Picture Trip!

A DILLER, A DOLLAR, AN Air Conditioned

Air view of S.M.U. campus in Dallas, Texas. One of the Southwest's finest universities, S.M.U. is also proud of such sports stars as recent football All-Americans Doak Walker and Kyle Rote.

• • • what makes you come so soon?

At Southern Methodist University, it's the prospect of cool, freshened classrooms . . . beyond the reach of Dallas' sometimes-100-degree heat. No sweltering, no stuffiness.

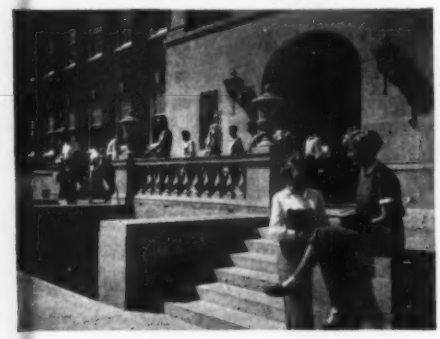
This air conditioning system at S.M.U. rates straight-A with students and faculty. Its pleasant, proper cooling reduces fatigue, promotes individual concentration, heightens interest . . . all vitally important to effective education and training.

Backbone of this system, behind the scenes, is the equipment contained in it. Large centrifugal refrigeration compressors chill and dehumidify the air to be circulated. The big motor driving this type of compressor must be especially suited to the job . . . for this, the new heavy-duty, variable speed E-M Wound-Rotor Induction Motor is a natural!

E-M VARIABLE SPEED DRIVE CUTS COSTS . . . ALLOWS ADJUSTMENT FOR MOST ECONOMICAL OUTPUT

Here's a point that will interest you. The load characteristics of a centrifugal refrigeration compressor enable you to drastically reduce compressor output with only a small reduction in motor speed. In this load and speed reduction, the losses in the motor are not unduly large. Hence, the compressor output can be adjusted over a wide range, and efficiency held to a maximum for greatest savings in power cost.

Another advantage of this Wound-Rotor Motor is its ability to start in small increments with very low current inrush. This minimum starting current avoids sharp voltage dips which might cause objectionable light flicker or possibly drop out other equipment on the line.



Front entrance to Fondren Hall, new science building, which combines the dignified grace of classic architecture with latest achievements in interior design and laboratory-classroom facilities.

A lecture room in Fondren Hall—one of the many S.M.U. buildings air conditioned throughout for comfortable, productive work and study. E-M Motor at right plays a big part in this air conditioning program.

Scholar...

• • • what's in it for *you?*

Picture these E-M Wound-Rotor advantages at work for you . . . flexible drive power enabling you to control speed, torque, and starting current:

High starting torque and low starting current if required . . . valuable for hard-to-start loads.

Suitable heat dissipation through long acceleration periods . . . an asset when starting high inertia loads.

Cushioning for high intermittent load peaks . . . often advantageous on chipper or crusher drives.

Continuous operation at reduced speed . . . just the thing for regulating output on centrifugal pumps, compressors, and fans.

Can you use some of these outstanding E-M benefits on your application? Why not find out . . . ask your nearest E-M sales engineer. E-M publication No. 198 will also interest you. Write the factory and ask for it.

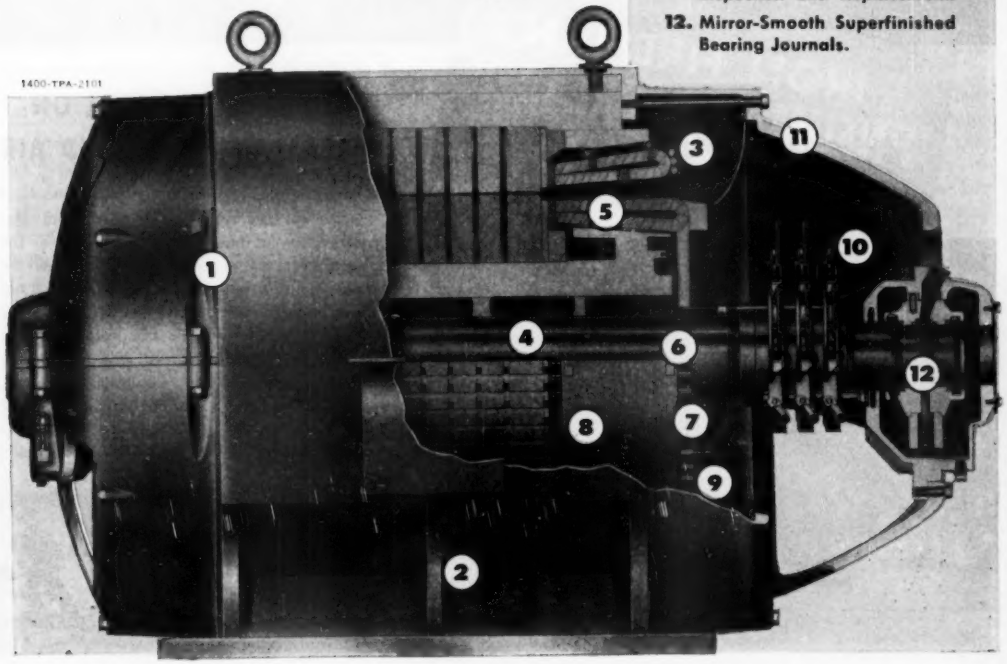
ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

E-M

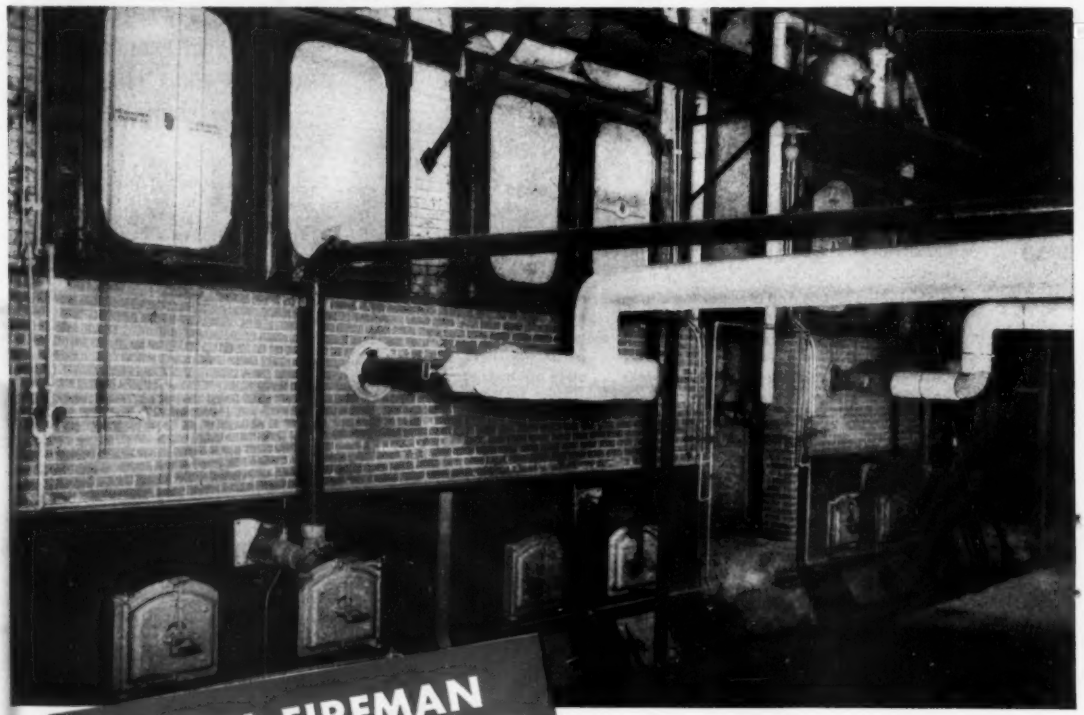
12 BIG FEATURES

DESIGNED BY ENGINEERS WHO KNOW WHAT YOU WANT IN BIG MOTORS:

1. **Drip Protection Sheds Liquid and Dirt.**
2. **Sturdy Steel Frame Can't Crack.**
3. **Long Life Stator Coils Tightly Braced.**
4. **Strongly Built Rotor.**
5. **Pre-Formed, Pre-Insulated Rotor Coils.**
6. **Precision Balance . . . Smooth Running.**
7. **Silver Brazed Coil Connections.**
8. **Stainless Steel Banded Coil-Ends.**
9. **Proper Ventilation with Copper Fin Blowers.**
10. **Uniform Brush Pressure Adjuster.**
11. **Easy Access to Brushes for Inspection and Replacement.**
12. **Mirror-Smooth Superfinished Bearing Journals.**



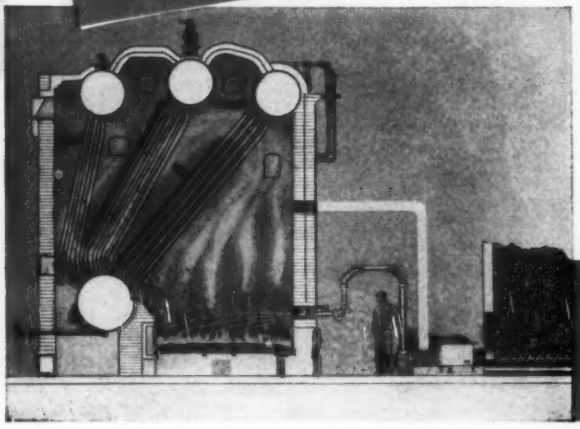
Coal handling and coal firing . . .



IRON FIREMAN PNEUMATIC SPREADER STOKER

CONVEYS DRY COAL ON STREAM OF PRE-HEATED AIR

Coal is thoroughly dried and pre-heated before it is conveyed pneumatically to furnace grates. Dry coal assures far more uniform distribution. The distributor nozzle spreads the dry coal over the *entire* grate in a shallow, uniform fuel bed and not simply on the front of the grate as is usually the case with wet coal. Preheated fines burn in suspension, reducing cinder carry-over and greatly improving combustion efficiency and responsiveness as compared with stokers which do not pre-heat coal.



IRON

. . combined IN ONE UNIT

HANDLES COAL AUTOMATICALLY
Cuts labor and equipment costs

DRIES AND PRE-HEATS COAL
Assures uniform fuel distribution

BURNS ECONOMY COALS
Reduces fuel costs

Burns all grades and types of **BITUMINOUS COAL** from ¼" slack to 2" top size

The Iron Fireman Pneumatic Spreader stoker is more than just a stoker. It is a complete COAL HANDLING AND COMBUSTION SYSTEM. No other stoker combines its many exclusive features and money saving "extras."

Manual coal handling or expensive handling equipment are completely eliminated—and without extra cost. Coal is conveyed pneumatically, direct from bunker or bin to the furnace grates.

The Iron Fireman Pneumatic Spreader stoker burns all grades and sizes of bituminous coals, including low ash fusion, sub-bituminous and lignite—ranging from ¼" slack to 2" top size. In addition, it is ideally adapted to burning the better quality grades of bituminous coal.

Coal is thoroughly dried and pre-heated before it is conveyed to the furnace and distributed over the grates. This assures far more uniform distribution over the *entire* grate.

Fuel feed and air volume rate are automatically synchronized. Air supply is kept in step with coal feed-rate at all times. The exclusive Iron Fireman infinitely variable transmission, combined with the Iron Fireman Volumeter, assures maximum efficiency at all rates of operation.

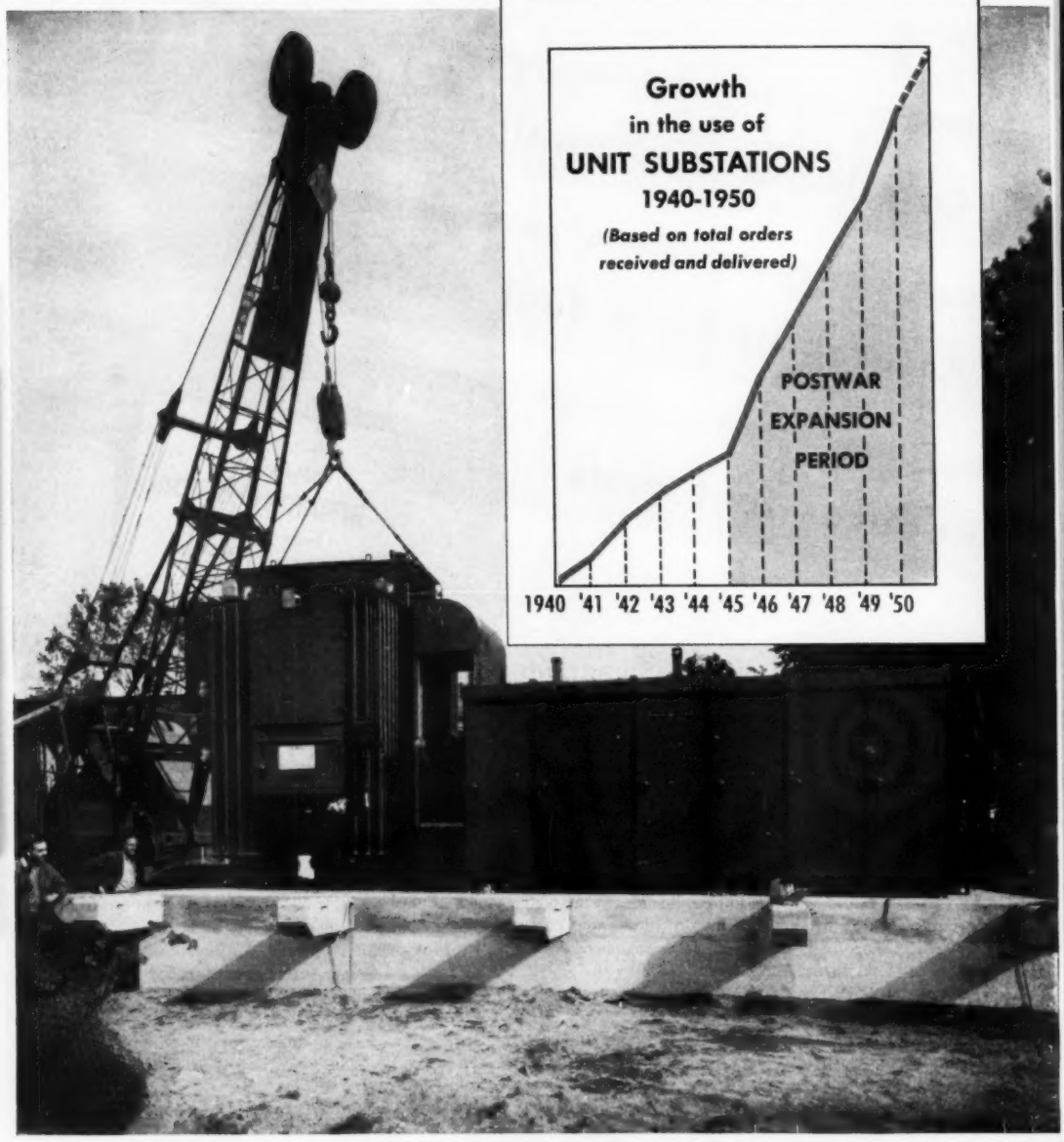
You save in other ways, too. The Iron Fireman Pneumatic Spreader stoker is readily adaptable to any boiler room layout—and without costly alterations. Coal bunkers or bins can be located in almost any position relative to the boilers—even on another level above or below the firing floor. Maintenance costs are low. All moving parts are located away from the direct heat of the combustion chamber. Easy to inspect and service. Capacities available to 1,000 boiler horsepower in single units. Multiple units for larger capacities.

Find out today how Iron Fireman firing will cut fuel and labor costs in your boiler room. A survey in your plant, made without cost or obligation to you, will show you. For such a survey, or descriptive literature, write Iron Fireman Mfg. Co., 3134 W. 106th St., Cleveland 11, Ohio, or call your nearest Iron Fireman dealer.

FIREMAN

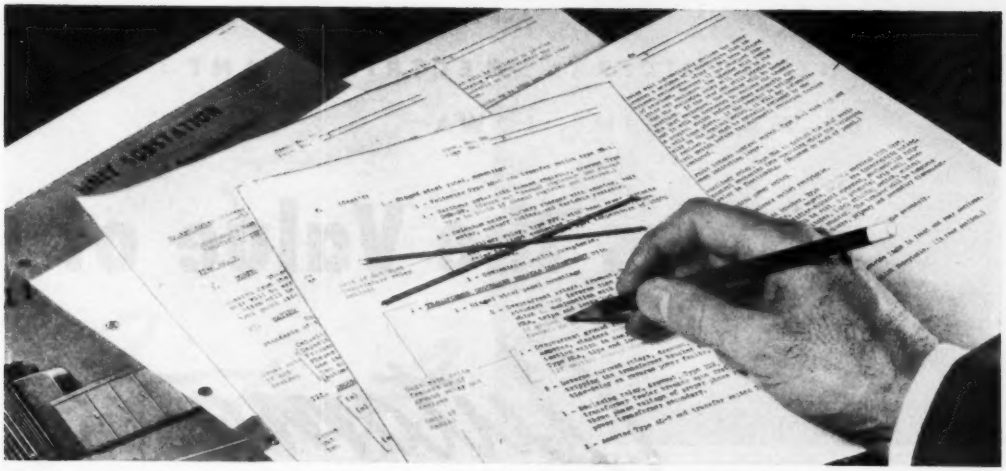
COAL, GAS, OIL FIRING FOR POWER, HEATING OR PROCESSING

Unit Substations—Key to



QUICK INSTALLATION: G-E unit substations come to you complete—ready for operation. You merely build the foundations, position the equipment and connect to your incoming and outgoing lines. Photo shows G-E unit substation being installed on the system of the Western Massachusetts Electric Co.

Fast, Low-cost Expansion



Simplified purchasing, ease of installation help in meeting fast-growing loads . . .

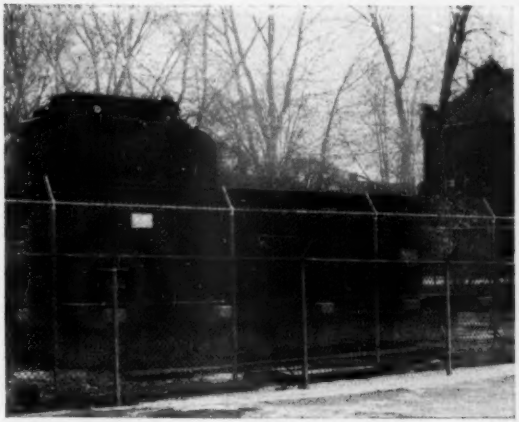
The rapid trend to factory-assembled unit substations—as shown in the chart at the left—seems sure to accelerate even more tomorrow.

Faced with the fastest-growing loads in history, utilities are finding these standardized, easy-to-install units one of their most valued tools in meeting expanding power demands quickly and at lowest cost.

Because of their great flexibility, compactness and adaptability, G-E unit substations are applicable to a wide variety of system arrangements. Standard, co-ordinated designs simplify planning and purchasing.

There's less worry about manpower and material problems. And proved, factory-engineered construction assures outstanding dependability. For full information, write for Bulletins GEA-3800 and GEA-4500. *General Electric Co., Schenectady 5, N. Y.*

WEEKS SAVED IN ORDERING! Basic guide-form specifications for G-E unit substations are available to you, and using these, you merely add ratings and number of circuits required and cross out details not applicable. Weeks are saved in detailing layouts and piecemeal ordering. Your engineers have more time for other system work.



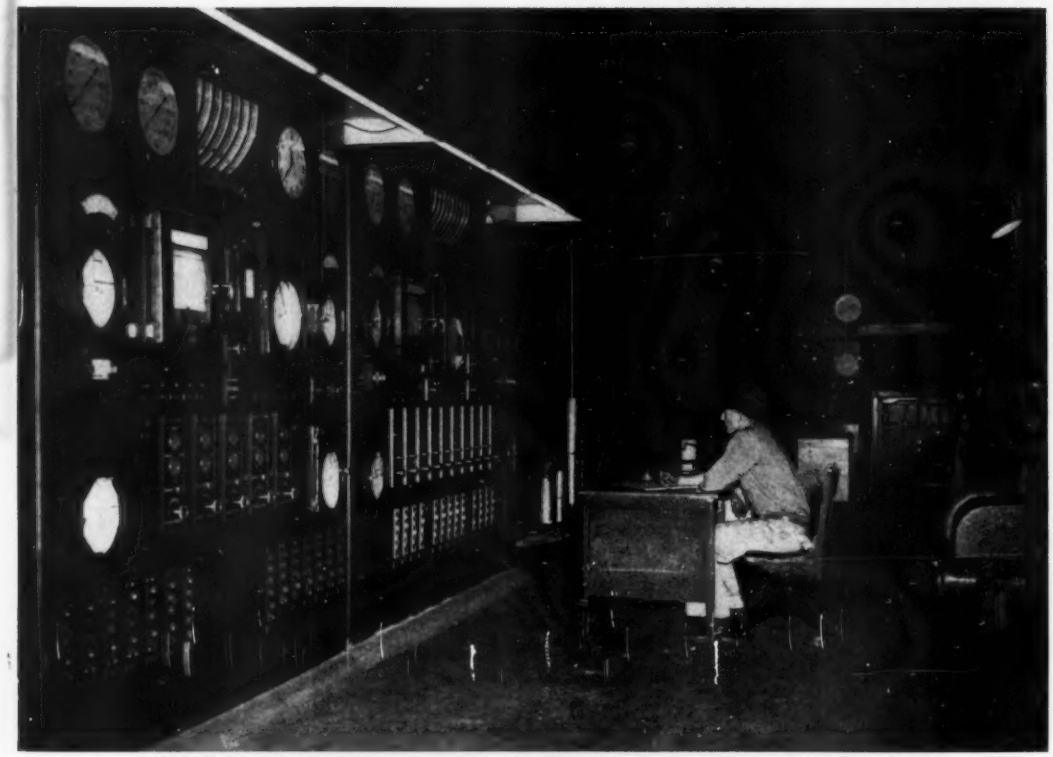
INSTALLED RIGHT AT LOAD: Compact, modern, attractive design of G-E unit substation enables it to be installed close to the load, even in many residential areas. Vital copper for secondary circuits is saved. The substation above was installed by the Western Massachusetts Electric Co. Note church in background.

321-74

GENERAL ELECTRIC

● THE MUNICIPAL ELECTRIC PLANT
of MUSCATINE, IOWA

Knows the Value of *Automatic*



Republic automatic boiler control and instrument panels at Muscatine Municipal Electric Plant

Republic regulator controlling fuel feed to stokers.

Control

● In 1941 the Municipal Electric Plant at Muscatine, Iowa, installed a modern 100,000 lb. per hr. steam generator. In 1948 a second boiler rated at 160,000 lb. per hr., 650 psi. was added.

In any steam electric generating plant, electric power rates and steam cost go hand-in-hand. Low steam cost however, is not the result of efficient boiler design alone. It is determined by the degree with which your method of boiler control takes full advantage of those economies which have been "built-in" the boiler and its auxiliaries.

To realize all the operating advantages of these modern boilers, each was equipped with a Republic automatic combustion and feed water control system at the time of installation. Built into the Republic control system are the many important features that enable it to fulfill all the conditions of theoretically perfect boiler control and still meet all the demands of everyday operation.

The installation of Republic automatic controls on your boiler (or boilers) will enable you to:—

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hours a day, 7 days a week.

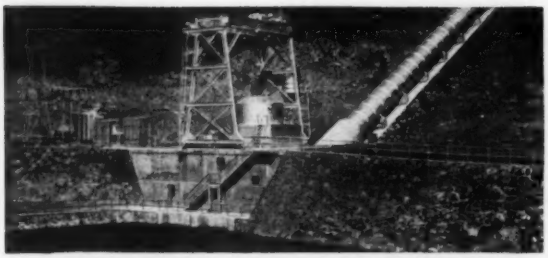
CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently develops as a result of incorrect boiler operation.

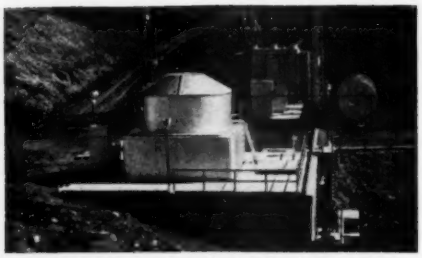
An automatic boiler control system, as designed and built by Republic, will help you meet today's need for more steam at lower cost.

Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

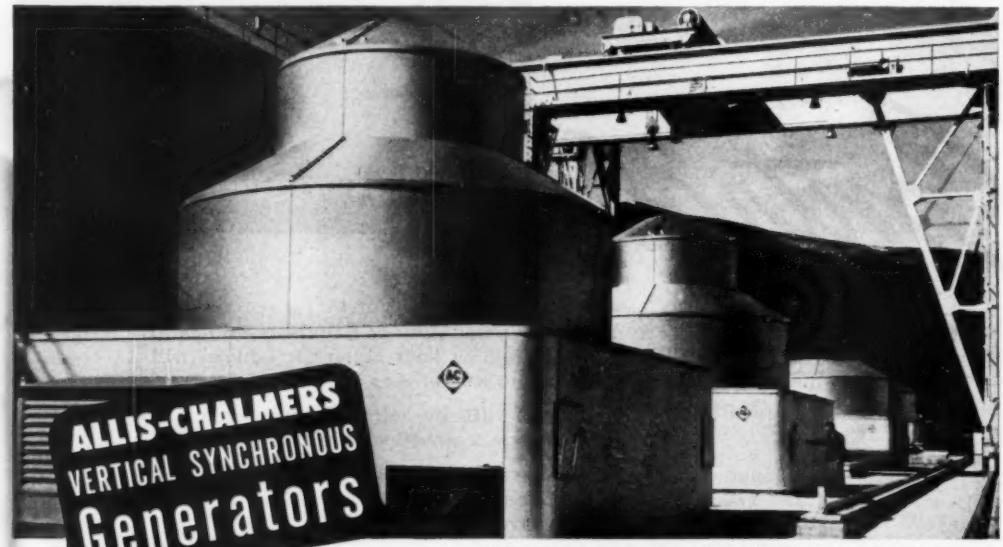


UPPER MALAD: One 8400 kva, 85.7% pf, 6900 volt, 225 rpm generator. Also, A-C 12,000 hp, 124 ft head Francis-type turbine, station-service substation, switchgear, main power transformer.



LOWER MALAD: One 15,500 kva, 87% pf, 6900 volt, 200 rpm generator. Also, A-C 22,000 hp, 157 ft head Francis-type turbine.

All generators are modified umbrella type (with upper guide bearings) furnished complete with outdoor housings.



LOWER SALMON: Four 17,500 kva, 86% pf, 13,800 volt, 120 rpm generators — two arranged for variable-pitch propellers. Also, A-C 12,000 kva power transformer.

"OPERATION AND MAINTENANCE ... Very Satisfactory"

THAT'S the verdict of Mr. Lester Garlinghouse, plant superintendent of Idaho Power's new Lower Salmon, Upper Malad and Lower Malad stations. It's natural that the six Allis-Chalmers hydraulic-turbine-driven generators in these stations should be highly satisfactory: They are the result of more than 40 years' experience designing and building large generators.

Placed in operation in 1948 and 1949, these generators supply southern Idaho as part of the Northwest power pool. The Malad stations, which are remote-controlled from the Lower Salmon station, operate 24 hours a day, seven days a week. Lower Salmon is used for load factoring (peak load operation) and runs at full load an average of about 10 hours a day every day of the year.

Whatever your power requirements are, you can rely on Allis-Chalmers for efficient, reliable generators custom-engineered for your installation. Types, ratings and construction features are described in new bulletin 05B7549. Contact your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wis.

A-3446

ALLIS-CHALMERS

Now more important than ever to you...

Fast LOCAL delivery

Convenient LOCAL warehouses

On-the-spot LOCAL lubrication engineering

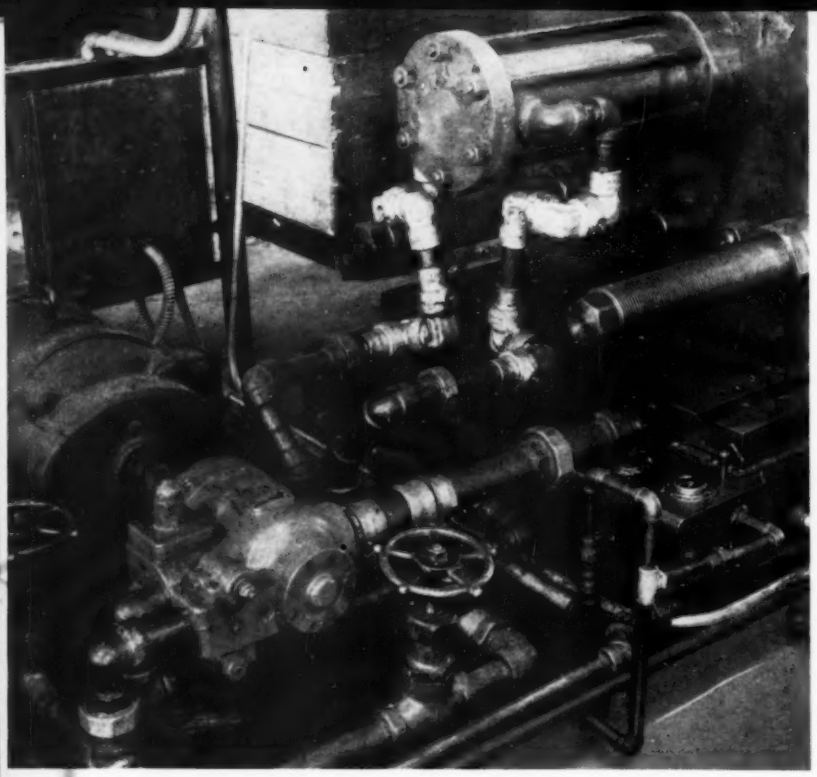
Standard's LOCAL Lubrication service

• Wherever you are located in the Midwest, there's a Standard service-supply center close at hand. That means prompt delivery of Standard products, immediate assistance from a Standard lubrication specialist.

There's no need to worry over possible production delays due to lack of the right cutting oil, lubricant, or fuel . . . no need to stock-pile these supplies in your own plant . . . no need to wait for help in solving your lubrication problems.

To take advantage of Standard's time-saving *local* lubrication service (now more important than ever to you) call the Standard office in your area. Or write: Standard Oil Company (Ind.), 910 South Michigan Avenue, Chicago 80, Ill.

STANDARD OIL COMPANY STANDARD (INDIANA)



5 years, no change of oil

THIS midwestern die casting company called in a Standard Oil lubrication specialist when operations were started over five years ago. One of his recommendations specified the use of STANOIL Industrial Oil No. 18 in the hydraulic unit of the die casting machine shown. Now, after five years of service, this original oil is still in nearly perfect condition. There is no deposit and no varnish in the hydraulic system. There has been no need to clean the system.

This performance is typical of the results gained by STANOIL users who count on its greater oxidation stability and corrosion resistance to deliver trouble-free lubrication in speed reducers, head stock gears, auxiliary turbines, and compressors, as well as hydraulic systems.

The Standard Oil lubrication specialist in your own area can help put the advantages of versatile STANOIL Industrial Oil to work in your plant now. A call to your local Standard Oil (Indiana) office is all that's necessary. Why not do it today?

Standard Oil Company, 910 South Michigan Ave., Chicago 80, Ill.

STANOIL
TRADE MARK
Industrial Oil

What's your problem?

D. R. Clay, lubrication specialist at Standard Oil's Grand Rapids office, helped this manufacturer put hydraulic system lubrication on a trouble-free basis with STANOIL Industrial Oil.

One of a corps of such specialists, he makes his headquarters close to the plants he serves. He offers on-the-spot lubrication service that is backed by extensive experience and training in the application of modern lubricants and fuels. The same service is available to you wherever you are located in the Midwest through the lubrication specialist in your own locality.

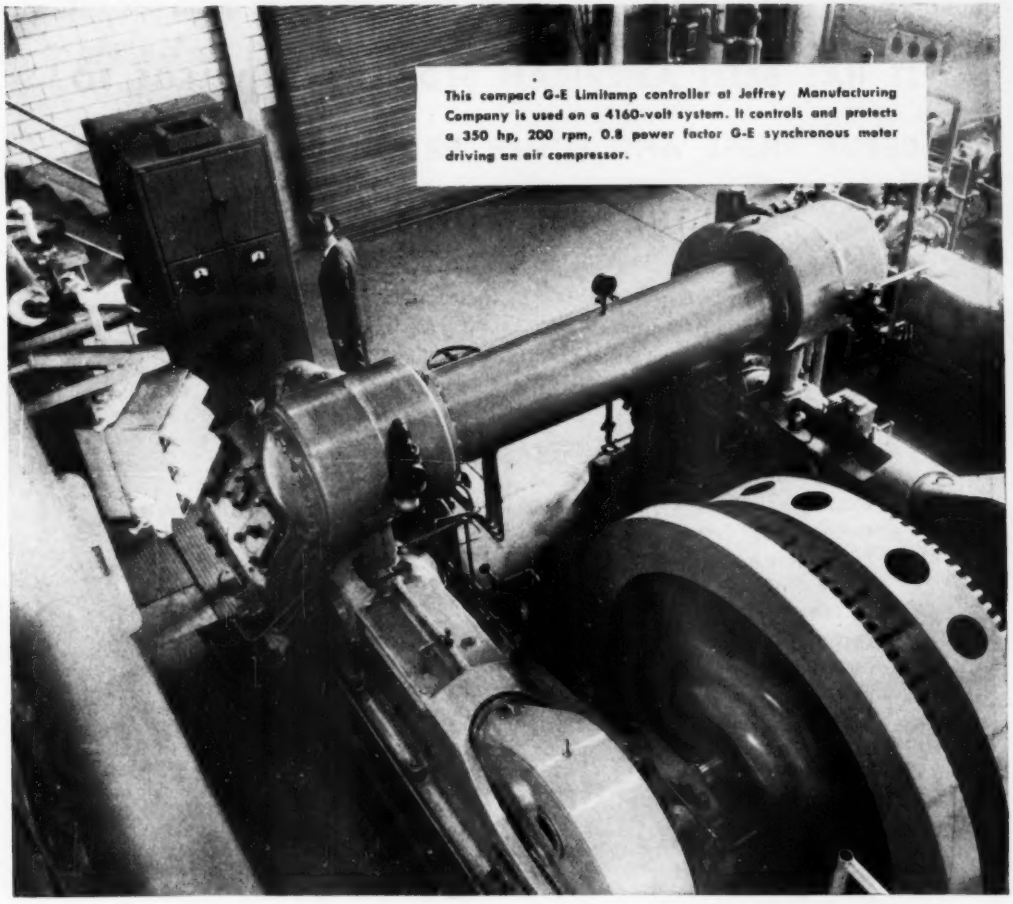
Arrange today for a visit by this specialist. Just phone or write the Standard Oil Company office nearest you. When he calls, ask for actual performance data on these outstanding products:

SUPERLA Greases—Available in a wide range of consistency grades and in both lime-soap and soda-soap types, SUPERLA Greases cover a wide range of operations.

STANORUST Rust Preventives—The eight grades of STANORUST form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specially developed for its intended use. The grades range from a fingerprint remover to a heavy semi-solid that protects against corrosion for years under the most severe outdoor exposure.

STANDARD OIL COMPANY STANDARD *(Indiana)*

Jeffrey Manufacturing Uses G-E Limitamp Control



This compact G-E Limitamp controller at Jeffrey Manufacturing Company is used on a 4160-volt system. It controls and protects a 350 hp, 200 rpm, 0.8 power factor G-E synchronous motor driving an air compressor.

This high-voltage control meets a need for ample interrupting capacity, protection for operating personnel, good appearance and compactness

The addition of a large compressor for general plant use called for a synchronous motor and dependable high-interrupting-capacity control at Jeffery's modern power house. In addition to the accurate synchronization obtained with the new field control of this air-break Limitamp controller, and the factors mentioned above, Jeffrey likes the co-ordinated design of this G-E controller that is factory engineered and built. Such a compact, steel-enclosed controller is easily installed, requires little space —yet has all the features that provide protection for both equipment and personnel. And it's quickly inspected and maintained.

Rapid duty cycles do not affect the long life inherent in G-E Limitamp —now available in ratings up to 4800 volts with an interrupting capacity up to 250 mva. Shorts are cleared in less than half a cycle—offering positive protection for your expensive electric equipment. Write for more information on the new Limitamp controller—also available for squirrel cage and wound rotor motor control—in Bulletin GEA-5409. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

710-27

IT HAS BEEN AMERICAN BLOWER'S PRIVILEGE TO SERVE THESE AND OTHER PRODUCERS OF POWER IN THE PUBLIC UTILITY FIELD

Buffalo Niagara Electric Corporation
Carolina Power and Light Company
Central Arizona Power & Light Company
Central Illinois Electric & Gas Company
Central Illinois Light Company
Columbus & Southern Ohio Electric Company
Connecticut Light & Power Company
Consolidated Edison Company of New York
Consumers Power Company
Consolidated Gas, Electric Light & Power Co. of Baltimore
Connecticut Power Company
Dairyland Power Co-operative
Dallas Power & Light Company
Detroit Edison Company, The
Duke Power Company
Eastern Shores Public Service Company
Fitchburg Gas & Electric Light Company
Florida Power Corporation
Florida Power & Light Company
Gulf Power Company
Hartford Electric Light Company
Indianapolis Power & Light Company
Iowa Public Service Company
Iowa-Illinois Gas & Electric Company
Iowa Power & Light Company
Iowa Electric Light & Power Company
Kansas City Power & Light Company
Kansas Power & Light Company, The
Kansas Gas & Electric Company
Long Island Lighting Company
Los Angeles, California, City of
Louisiana Power & Light Company
Madison Gas & Electric Company
Mississippi Power Company
Missouri Power & Light Company
Nebraska Power Company
Northern Indiana Public Service Corporation
Ohio Edison Company
Oklahoma Gas & Electric Company
Omaha Public Power District
Otter Tail Power Company
Pacific Gas & Electric Company
Pennsylvania Power Company
Philadelphia Electric Company
Potomac Electric Power Company
Public Service Company of Oklahoma
Public Service Electric & Gas Company
Public Service Company of Colorado
Southwestern Public Service Company
Southern Indiana Gas & Electric Company
South Carolina Power Company
Springfield, Illinois, City of
Tampa Electric Company
Texas Electric Service Company
Texas Power & Light Company
Tennessee Valley Authority
Virginia Electric & Power Company
Worcester County Electric Company of Massachusetts

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN

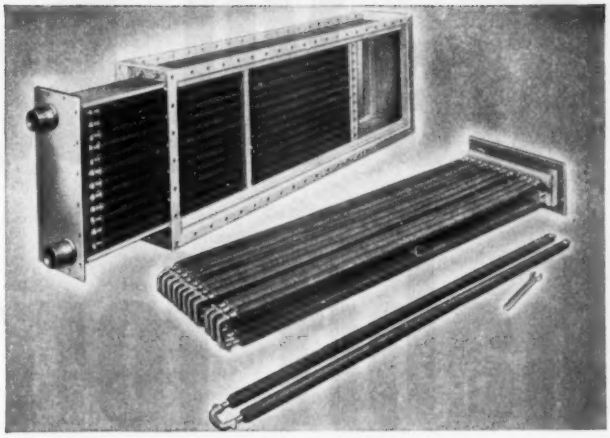
Serving home and industry

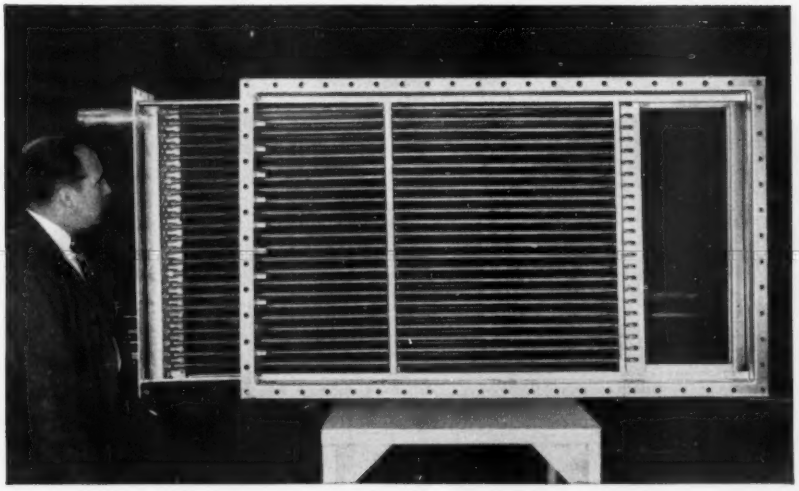
AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Facts you should know about

AMERICAN BLOWER HEAVY DUTY STEAM COILS

American Blower's Type H Heavy Duty Steam Coil has been developed for a single purpose: to furnish public utilities and industry with a heating coil designed and built in accordance with highest quality industrial equipment standards. It is a coil possessing strength, corrosion resistance and complete accessibility.





↑ Above. Type H Heavy Duty Coil and component parts. The entire heating element is removable from the casing and can be completely dismantled for inspection, maintenance and repair. Individual tubes are replaceable.

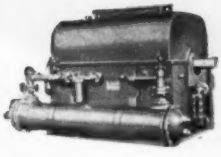
← Type H Coils are available in a wide range of sizes and are designed, tested and guaranteed for operation with steam pressures to 350 lbs. gauge. Casing is heavy steel, welded airtight.

For detailed information on American Blower Type H Coils, write for Bulletin B-1318, or call our nearest branch office.

And if you'd like complete data on other American Blower power plant equipment — Mechanical Draft Fans, Fly Ash Precipitators and Gyrol Fluid Drives for boiler feed pumps and fan control — write, stating your requirements, or phone the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation



Gyrol Fluid Drives

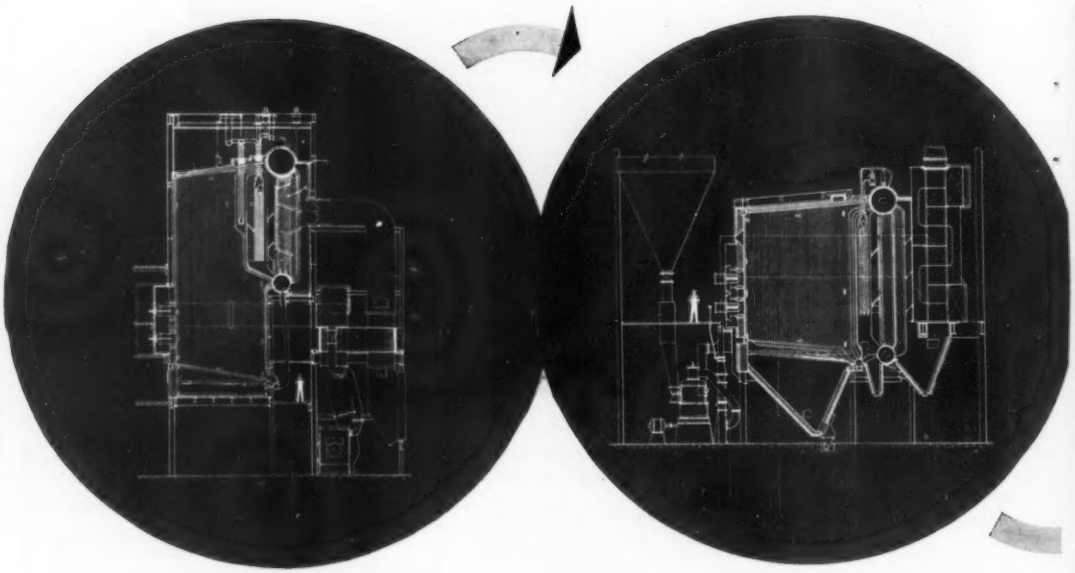
for Mechanical Draft Fans are also a part of American Blower's wide range of products which serve America's leading public utilities.

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Are VU Boilers habit forming?



VU-50 Boiler fired with oil. The capacity of the unit shown is 350,000 lb of steam per hour; operating pressure—920 psi; total steam temperature—905 F.

VU-50 Boiler fired with pulverized coal. The capacity of the unit shown is 150,000 lb of steam per hour; operating pressure—625 psi; total steam temperature—760 F.

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

The record shows that they are. More than 100 companies . . . large and small . . . throughout this country and abroad . . . have ordered VU units more than once. Nearly half of these have ordered more than twice. Some as many as 5 or 6 times.

Considered in light of the fact that Vertical-Unit Boilers have never been — nor are likely to be — the cheapest you can buy, such a record becomes even more significant.

Here are just a few examples of the many industries that appear to have formed the VU habit.

A Steel Company now has a total of eleven VU Units in three different plants. Starting with an initial installation of three units in 1940, it has reordered twice; three units for a second plant in 1946 and five units for a third plant in 1950.

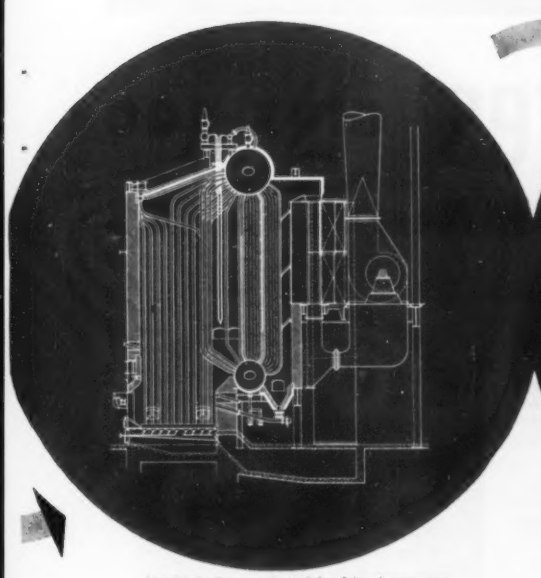
An Electric Utility Company started using the VU in 1944 when two units were installed at one of their power stations. When the capacity of this station was increased in 1948 two more units were installed. In 1947 this company ordered two more units for another of its stations.

An Oil Company ordered its first VU in 1937, its second in 1938. In 1942 another VU was installed and still another in 1944.

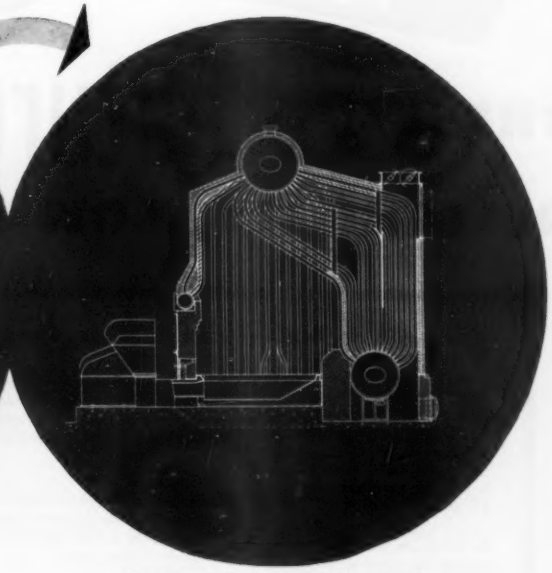
An Aluminum Company is another consistent buyer of VU Units. Since installing its first VU in 1940, it has reordered four times, and now has five C-E Vertical-Unit Boilers in service.

* * *

Just a small sample to be sure, but one that can be repeated over and over for other industries and other companies . . . companies that have ordered and reordered VU Boilers . . . companies that have the "VU habit" and find it highly profitable. B-511

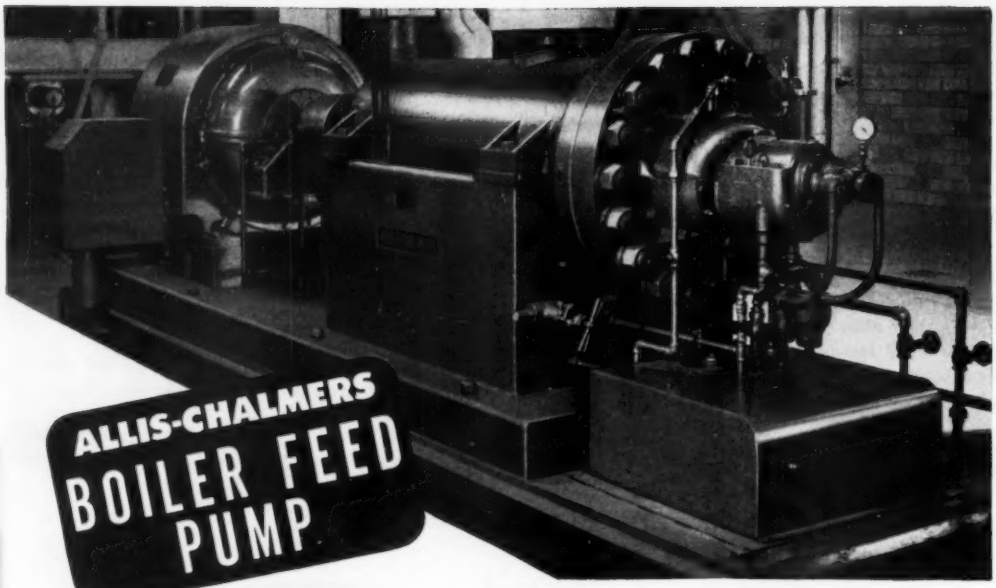


VU-50 Boiler as adapted for firing bagasse on a C-E Spreader Stoker. The capacity of the unit shown is 75,000 lb of steam per hour; operating pressure—160 psi; total temperature—530 F.



VU-10 Boiler fired with C-E Skelly Stoker. VU-10 Boilers range in capacity from 10,000 to 60,000 lb of steam per hour. They may be fired by underfeed, spreader or chain grate stokers or by oil or gas.

— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.
C-E



THESE 7 Features GIVE YOU RELIABILITY, LOW MAINTENANCE

1. Single stage, back-to-back impellers balance axial forces without use of balancing drum. Two impellers in first stage give advantages of double suction at this point.

2. Volute casing provides high efficiency and radial balance. Volute design also simplifies construction for easier maintenance.

3. Expansion joint is brought to outside of pump where leakage may be quickly detected and adjustments made without dismantling the pump. No flexible internal members are required for expansion compensation.

4. Packing is also located where it may be adjusted easily and quickly.

5. Uniform section of both inner and outer casings assures uniform expansion at all points. Expansion stresses are minimized; alignment is held.

6. Casing halves are held together with full hydraulic pressure of the pump assuring a tight seal with a minimum of heavy parts.

7. A carriage which may be attached to the pump body is furnished with each unit. The inner casing may be withdrawn from the outer casing on this carriage, making servicing easy and quick.

HERE IS A PUMP designed to meet the needs of the newer high pressure boiler plants. Efficiency is high, maintenance is low and every feature has a long record of successful application to boiler feed service.

Sizes range from 1200 to 2500 psig and from 300 to 2000 gpm. Allis-Chalmers can supply the complete boiler feed pump installation including pump, motor and control of coordinated design and manufacture.

Get the details on this new boiler feed pump from your Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3407

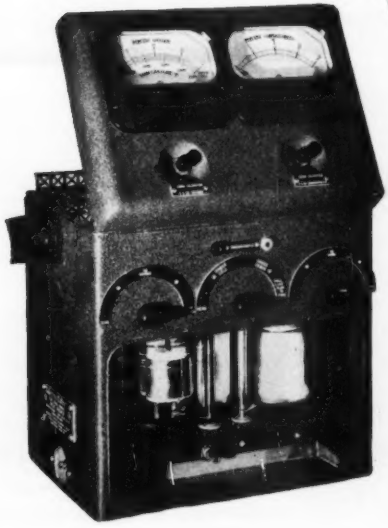
ALLIS-CHALMERS

Mobilizing BTU's

Now that the "heat's on" for record production, the calls are increasing for the services of the Cities Service Heat Prover. This scientific instrument gives an accurate, instantaneous and continuous picture of combustion conditions in all types of furnaces.

You'll readily be able to calculate any oxygen excess, waste combustible matter, and potential fuel savings. The results are like an accurate "diagram" of corrective measures needed to conserve heat units for consistently higher production at lower cost.

You'll see profit in applying the Cities Service Heat Prover . . . *not an instrument you buy, but a service we supply!* Call or write your local Cities Service office about arrangements. Or simply return the coupon today.



THE COMPLETE CITIES SERVICE LINE FOR THE METAL FABRICATING INDUSTRY INCLUDES

Chillo Cutting Oils • Trojan Greases • Trojan Gear Oils
Pacemaker T Hydraulic Oils • Optimus Cylinder Oils
Q-T (Quenching and Tempering) Oils

CITIES SERVICE OIL CO.
Sixty Wall Tower, Room 113
New York 5, N. Y.

Without obligation please send your booklet, "Combustion Control for Industry."

Name_____
Company_____
Address_____
City and State_____

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

Do you have boiler like these?

Here are 8 "case histories" telling how leading companies solved their boiler plant problems. You'll note that there are small boilers and large boilers—all types of fuels, including alternate fuels—different load characteristics—and different uses for steam.

The two things all these plants have in common are HAYS COMBUSTION CONTROL and a record of continuing excellent results—top efficiencies, greater capacity, high CO_2, reduced fuel, labor and maintenance expense, etc.

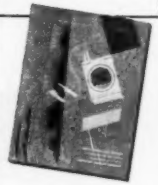
In each boiler plant, Hays instruments and control were tailored to the specific conditions and requirements . . . "packaged" in a handsome panel . . . and engineered for the results desired.

Here's how to find out the details which can help you in solving your boiler plant problems. Select the "case history" which is close to your conditions and requirements—and then check the attached coupon. You'll get complete factual details of the boilers and related equipment, load characteristics, fuels, and fuel handling, as well as an explanation of the operation of the control system complete with schematic drawings.

get these factual

RESULTS STORIES

	To recondition or add new boiler To get better process load regulation	To get better efficiency. To get more out of boiler due to rising load
	AMERICAN TOBACCO COMPANY	RAYBESTOS-MANHATTAN COMPANY
BOILERS	Three (one standby)	Four
RATING	16,500 lb per hr	19,650 lb per hr
LOAD SWINGS	Total fluctuation up to 20,000 lb per hr	Moderate load swings
FUEL	Coal	Coal
STEAM USE	Power and process	Process pumps, compressors and heating
results	"The Hays instruments and controls through greater efficiency . . . gave us the solution . . . that of increasing steam capacity and accurate automatic control of the load."	"Our basic reason for installing the Hays Control was to obtain better efficiencies. Our aim was more than reached . . . efficiency . . . 79.3%."



American Tobacco Co. Raybestos-Manhattan Co.

THE **HAYS** CORPORATION
MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

plant problems

To make possible easy future expansion with maximum fuel flexibility	To lower operating costs while handling load fluctuations	To modernize plant and to increase boiler plant efficiency	To get accurate control of pulverized coal and oil firing through load swings	To meet varied manufacturing demands and to achieve savings in fuel and labor	To get greater capacity while operating at top efficiency
A. B. DICK COMPANY	**SUNSHINE BISCUIT COMPANY**	**FALSTAFF BREWING CORPORATION**	**BEMIS BROS. BAG COMPANY**	**BALDWIN LOCOMOTIVE WORKS**	**SCOVILL MFG. CO.**
Three	One, plus steam generator incinerator	One	Two	Three	Two
25,000 lb per hr each	31,500 lb per hr	48,000 lb per hr	70,000 lb per hr and 80,000 lb per hr	160,000 lb per hr	One 225,000 lb per hr One 150,000 lb per hr
5—10,000 lb per hr fluctuation without warning	Daily variation 20,000 lb per hr	Fluctuates 12,000 to 28,000 lb per hr	Daily variation 15,000 lb per hr	Intermittent, no warning swings up to 100,000 lb per hr	Load swings up to 60,000-70,000 lb per hr
Coal or gas	Oil	Coal	Oil and coal	Coal and oil	Coal and oil
Heating and process	Process	Heating and process	Power, process and heating	Heating and process	Power, heating and process
"Because of its simplicity (Hays Combustion Control) has enabled us to change quickly from coal to gas firing... aided us to achieve 73% efficiency rating in winter—71% in summer."	"Our management and operating crew are well pleased with the new (Hays) unit ...low maintenance costs... equipment enables us to keep close watch over our operating costs."	"Our boiler is operating at 82% efficiency and our maintenance expense bill has been cut 65%...our fuel bill has decreased by several hundred dollars per month."	"We have made test runs using the Hays Automatic Combustion Control System, bringing the load rapidly up from 8,000 lb per hr to 80,000 lb per hr with excellent results."	"Our Hays Combustion Control System has aided us substantially in cutting our fuel, labor, and maintenance expense... saved 30,000 tons of coal per year ...we operate with 42 less men than were formerly used."	"We are meeting steam demands up to 400,000 lb per hr achieving an evaporation rate of 12.8, a fuel cost per kw of $.0049, and a cost per 1,000 lb of steam of $.706."

A. B. Dick Company

Sunshine Biscuit Co.

Falstaff Brewing Corp.

Bemis Bros. Bag Co.

Baldwin Locomotive Works

Scovill Mfg. Co.

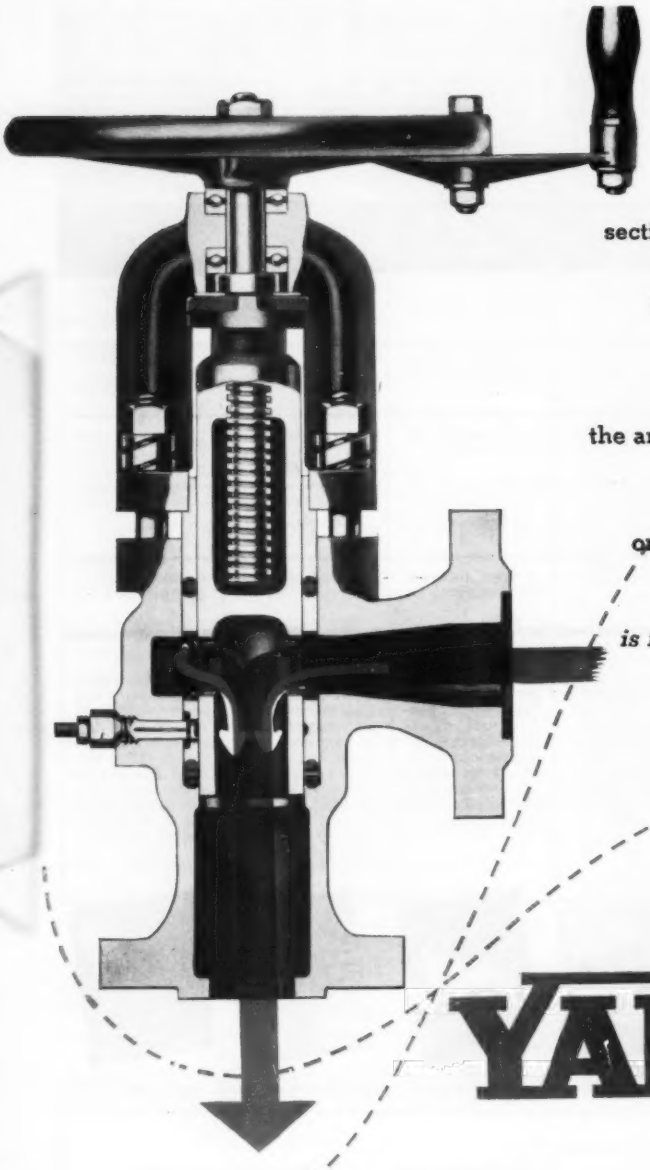
The Hays Corporation, Michigan City 3, Indiana
I've checked the RESULT STORY(S) that cover the conditions in my plant. Please send it immediately.

☐ American Tobacco Co. ☐ A. B. Dick Company ☐ Falstaff Brewing Corp. ☐ Baldwin Locomotive Works
☐ Raybestos-Manhattan Co. ☐ Sunshine Biscuit Co. ☐ Bemis Bros. Bag Co. ☐ Scovill Mfg. Co.

Name_____ Address_____

Title_____ City & State_____

OPEN AND



Take a look at these two sectioned pictures of a Yarway Seatless Blow-Off Valve. They show the reasons why more than 15,000 boiler plants use Yarways.

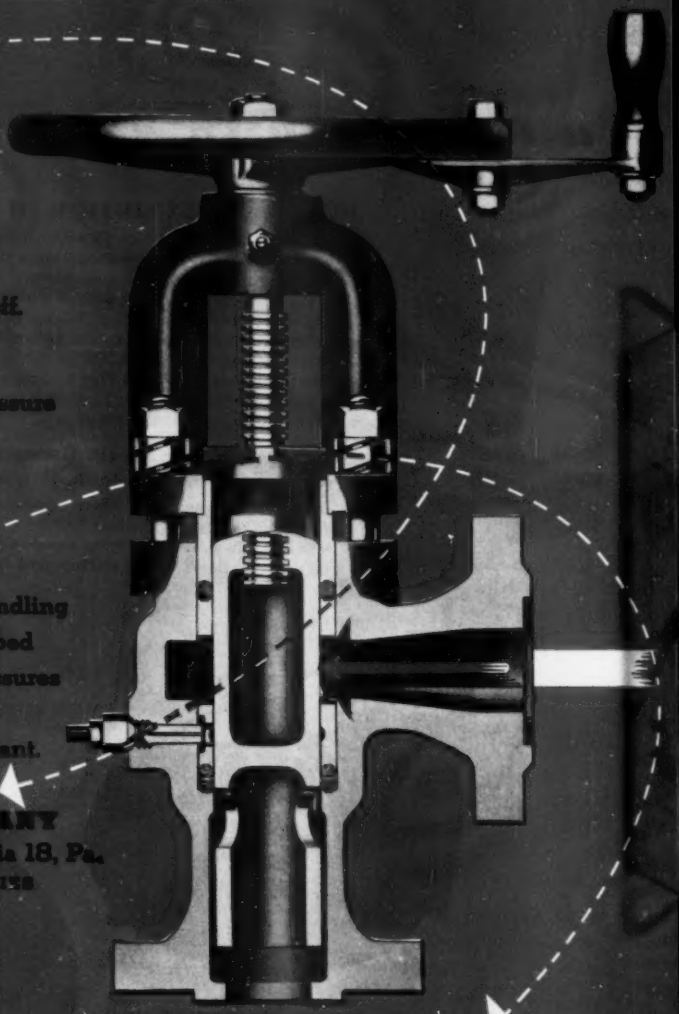
Notice in the open valve, at left, the ample space provided for free flow of blow-down through the hollow plunger. There are no projections or pockets to catch scale or sediment.

Notice particularly that *there is no seat to score, wear, clog or leak.* That most troublesome part of a blow-off valve has been eliminated!

YARWAY

KEEP BOILERS ON THE GO

SHUT CASE



Now look at the closed valve, at right. In this position, packing rings are compressed around plunger, insuring drop tight shut-off.

Tension springs under the yoke nuts help maintain continuous pressure through the glands on packing rings, keeping the valve tight.

There are other reasons, too . . . such as nitralloy plungers, special metallurgical improvements for handling acid wash, etc. They are all described in Yarway Bulletin B-425 for pressures to 400 psi, or B-433 for higher pressures. Write for the one you want.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

BLOW-OFF VALVES

BY STOPPING BLOW-DOWN TROUBLES **STOP**

a long way in a short time . . .

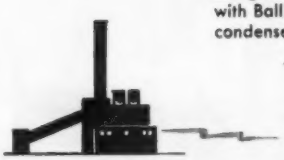
FIVE-FOLD EXPANSION IN TEN YEARS

The large up-to-the-minute steam-electric station, depicted here, again furnishes proof of management's desire to keep up with the needs of a growing economy.

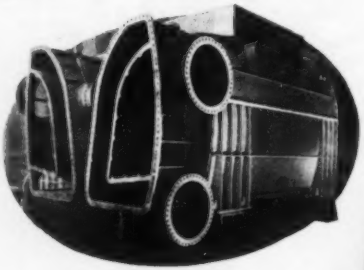
The area served by this central station consists of free-enterprising people who depend on an uninterrupted and adequate source of electric power for their growing industries. The Midwest Utility which serves this community built its first 60,000 kw unit in the area in 1942 to meet the industrial needs of World War II. Today a five-fold expansion program, which will bring the station's installed capacity up to 300,000 kw, is drawing to a close.

Foster Wheeler Steam Generators, Condensers, and Auxiliary Steam Generating Equipment

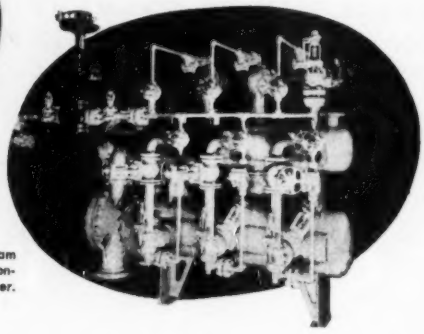
The Foster Wheeler installations which contribute so largely to the success of this great undertaking include four 640,000 lb per hr steam generators with Ball Mill Pulverizers, firing equipment, and plant equipment including condensers, steam jet air ejectors and feedwater heaters.



FROM 60,000 to 300,000 KW

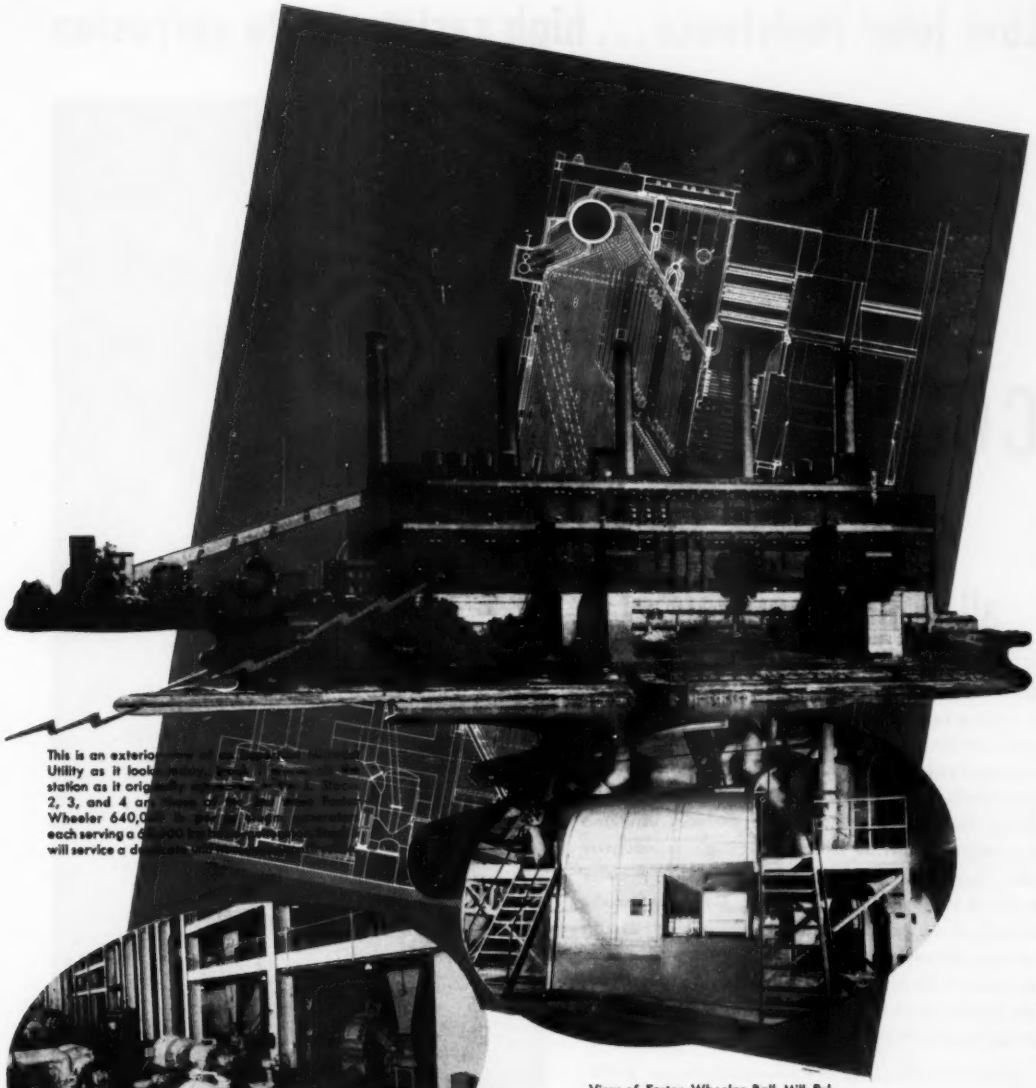


Shop photograph of one of the 55,000 sq ft Foster Wheeler surface Condensers serving the 60,000 kw turbines.



Shop view of a Foster Wheeler steam jet air ejector which removes non-condensible gases from the condenser.

FOSTER WHEELER



This is an exterio… Utility as it look… station as it orig… 2, 3, and 4 ar… Wheeler 640,0… each serving a d… will service a d…

View of Foster Wheeler Ball Mill Pulverizer, one of twelve which will be in service when the station is completed.

View of operating floor with exhauster of Foster Wheeler ball mill in right background.

CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

Low joint resistance... high resistance to corrosion

POWER CONNECTORS

Silver plated on all contact surfaces!

Silver on all current-carrying surfaces is just one of the ways in which G-E power connectors reduce joint resistance and minimize corrosion. Carefully regulated copper content of connector alloy provides current-carrying ability equal to that of conductor. Sharp, machine-serrated contact surfaces bite into the conductor, giving a permanent high conductivity joint that resists vibration and maintains positive pressure at all times. Interlocking sides confine the strands of the cable within the enclosure, reducing inter-strand resistance and taking full advantage of the cable's current-carrying capacity. Non-corrodible hardware of high-strength bronze alloy assures permanent tightness of connections.

There's a wide range of types—straight, tee, block, angle, parallel, expansion, ground, and many others. Why not place a trial order with your G-E sales representative? Write for Bulletin GEC-400—it contains 44 pages of valuable connector information. Section 856-57, General Electric Company, Schenectady 5, N. Y.

856-57

GENERAL ELECTRIC

One of a series of case histories from the records of Hall Laboratories, Inc.

THE CASE OF THE PLANT THAT DIDN'T NEED HALL SERVICE

An executive, new to a mid-west public utility plant, had utilized Hall Service in previous years. When he checked to see if this plant used Hall Service, the Superintendent, with years of trouble-free operation to his credit, said he didn't need it.

Then a second high pressure boiler was installed. Shortly thereafter, the screen tubes of the older high pressure boiler failed because of steam blanketing. About the same time, the wall tubes of the new boiler failed at the welds, as did replacement tubing. Nothing like this had ever plagued the Superintendent before, so he called in Hall Laboratories.

Hall Engineers suspected the trouble, and a metallographic examination of specimens confirmed their suspicion. The answer? Hydrogen embrittlement, resulting from corrosion at the field welds.

Hall Engineers made their recommendations. After an acid cleaning of the boilers, the alkalinity of the boiler water was increased to maintain a low controlled level of free caustic soda. Spirals of sheet steel were placed in the screen tubes of the older boiler to spin the water to keep the tops of the tubes wet. Result—unscheduled outages stopped.

The moral is that it's thrifty to maintain Hall Service through trouble-free years to be protected when conditions outside normal experience arise. Hall Engineers are on guard for conditions like those preceding hydrogen embrittlement. Whatever your problems in the "water business", the years of experience at Hall Laboratories *are your experience*, for the asking.

HALL LABORATORIES, INC.

(A SUBSIDIARY OF HAGAN CORPORATION)

HALL SYSTEM OF BOILER WATER CONDITIONING

CONSULTANTS ON
PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

Hall Laboratories, Inc., Hagan Building, Pittsburgh 22, Pa.

Please send me your bulletin: Let's Consider Your *Whole* Water Problem.

Name_____

Position_____

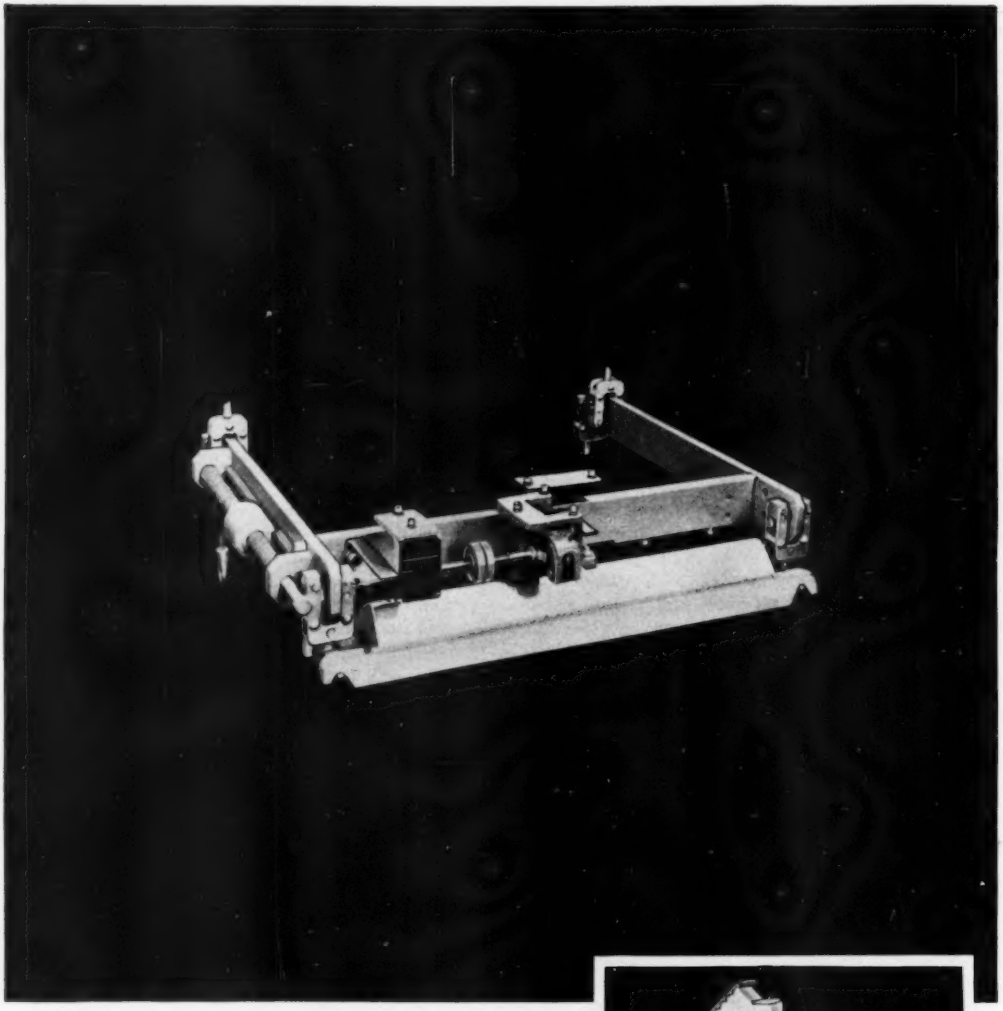
Company_____

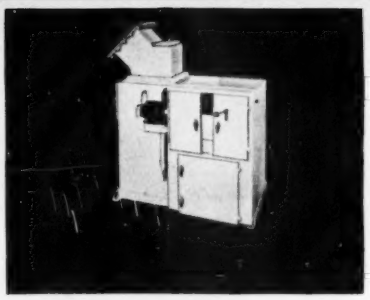
Street & Number_____

City_____ Zone_____ State_____

P-9

S-E-Co. Coal Scales Are Accurate





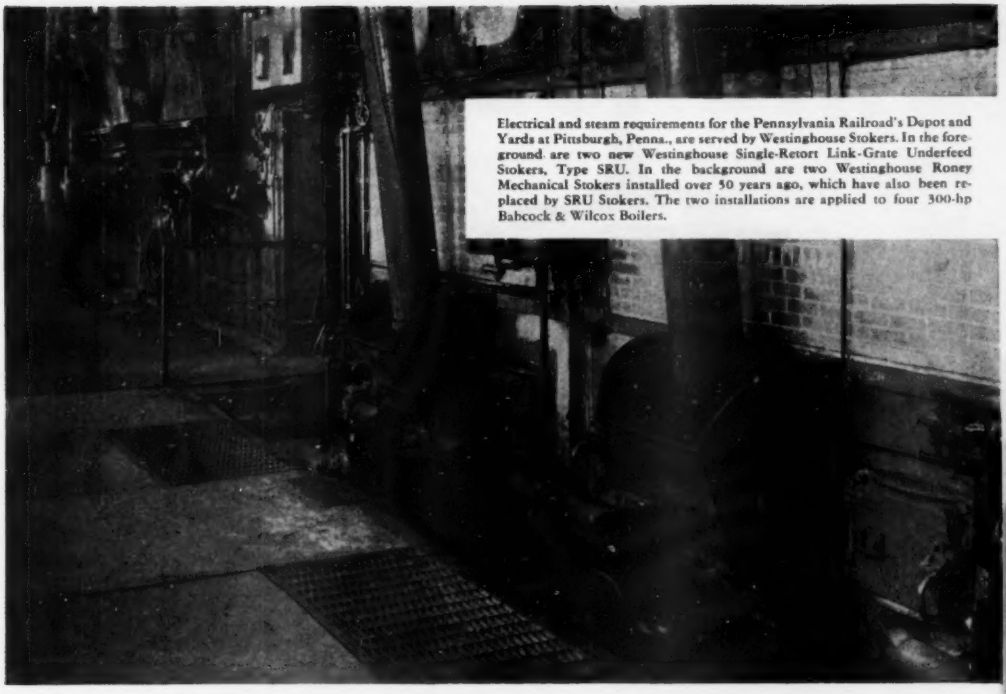
S-E-Co. Coal Scales utilize a non-welded steel weigh lever system, steel loops, hardened steel pivots and bearings which give a minimum weight to these parts. This light weight means low inertia, faster action, and therefore a greater accuracy.

Weigh levers that are not welded, do not warp—therefore pivots are in exact alignment and remain so. The entire lever system is located in a dust tight compartment.

For an accurate weight of coal fed to your pulverizer or stoker, use **S-E-Co.** Coal Scales.

SEND YOUR INQUIRY TO **STOCK EQUIPMENT COMPANY**

715 P HANNA BUILDING • CLEVELAND 15, OHIO



Electrical and steam requirements for the Pennsylvania Railroad's Depot and Yards at Pittsburgh, Penna., are served by Westinghouse Stokers. In the foreground are two new Westinghouse Single-Retort Link-Grate Underfeed Stokers, Type SRU. In the background are two Westinghouse Roney Mechanical Stokers installed over 50 years ago, which have also been replaced by SRU Stokers. The two installations are applied to four 300-hp Babcock & Wilcox Boilers.

One Long Run Deserves Another...

50 years of dependable service!

At the turn of the century, the Pennsylvania Railroad installed a bank of Westinghouse Roney Mechanical Stokers in their Pittsburgh Depot. After 50 years of dependable service... with a minimum of maintenance... they have been replaced by underfeed stokers.

Recently, it was found necessary to increase the capacity, and the Pennsylvania Railroad replaced the Roney Stokers with four Westinghouse Single-Retort Link-Grate Underfeed Stokers. The new Westinghouse Type SRU Stokers will burn a wider range of bituminous coals at better efficiency. This means savings in both higher efficiency and the use of low-priced coal, which can repay the entire installation costs within a short time. Smokeless operation at all loads is assured.

Westinghouse Single-Retort Stokers give medium-sized plants the advantages of underfeed stoker firing where available space and load do not justify the use of multiple-retort stokers.

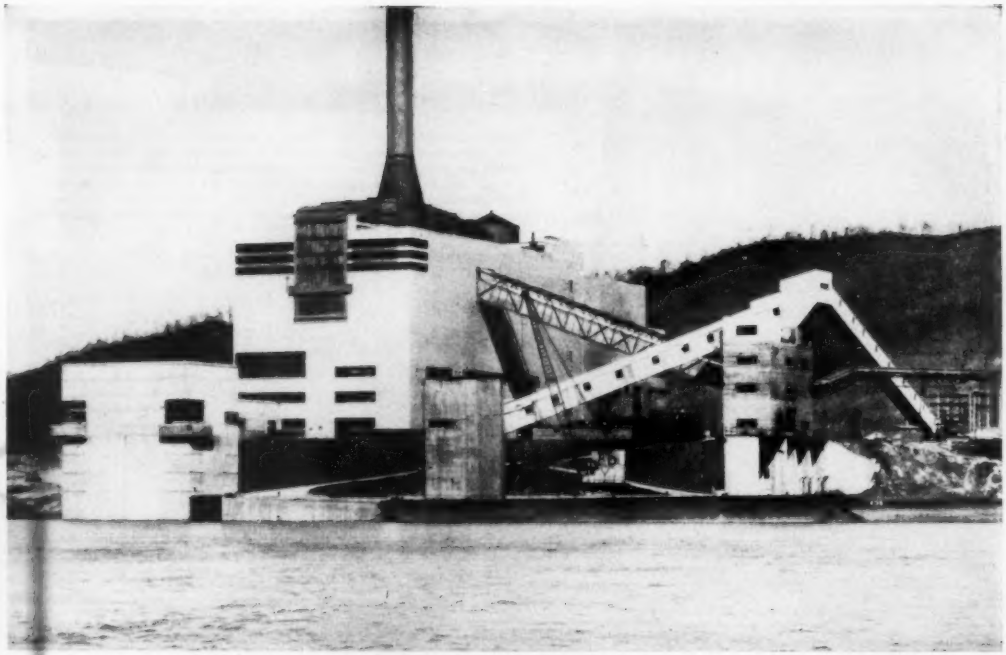
Available with stationary and link grates, they may readily be applied to any boiler within a capacity range of 10,000 to upward of 30,000 lbs. steam per hr., base load. Get all the facts from your nearest Westinghouse representative . . . or write for Booklet B-4764, Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-50531

YOU CAN BE SURE... IF IT'S

Westinghouse

STOKERS



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

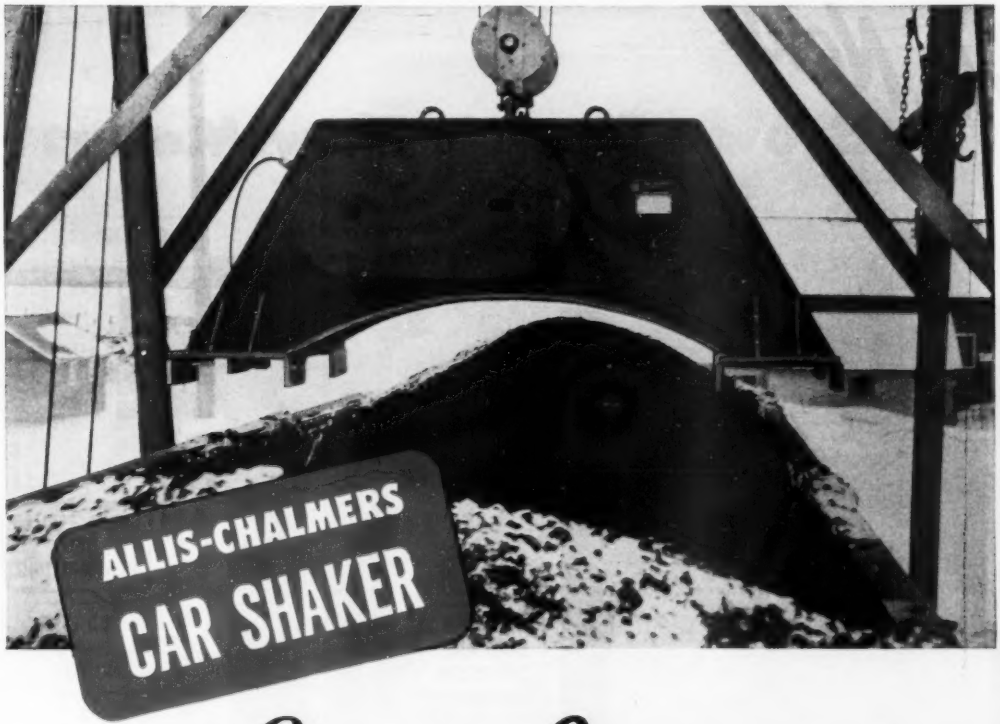
Z.1.1

WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers

FAST UNLOADING



...and Sturdy Construction

BESIDES BIG SAVINGS in man-hours and demurrage costs, operators report savings in maintenance and downtime with Allis-Chalmers car shakers. And no wonder! Allis-Chalmers has designed these units for long, dependable service without trouble. For example:

- Shaker body is one-piece, all-welded structure made of 1 in. thick reinforced steel plate and stress-relieved to eliminate welding strains.
- Motor and drive are totally enclosed within shaker body, protected from weather and accidental injury. Motor is mounted in a special cradle base and protected from vibration damage with multiple shear mountings.
- Extra large bearing — 11⅞ in. outside diameter. Long bearing life! Heavy duty shaft arranged for hydraulic bearing removal.

Get more facts about how Allis-Chalmers car shakers can save money in your operations. Call the A-C representative in your area. Allis-Chalmers, Milwaukee 1, Wisconsin.

Car Shakers Promote Safety to Personnel!

ALLIS-CHALMERS

Allis-Chalmers Mfg. Co.
Milwaukee 1, Wis.

Please send my copy of Car Shaker Bulletin 07B7221A.

Name .....

Title .....

Firm .....

Address .....

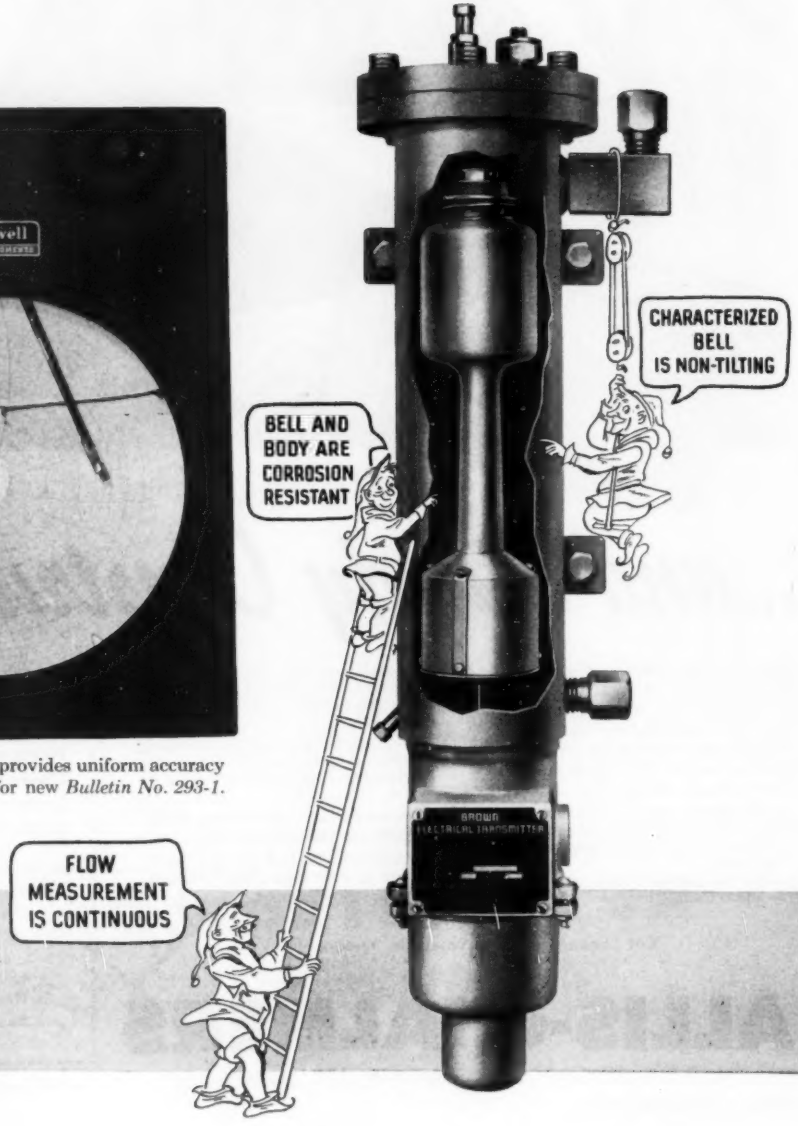
City ..... State .....

A-3468

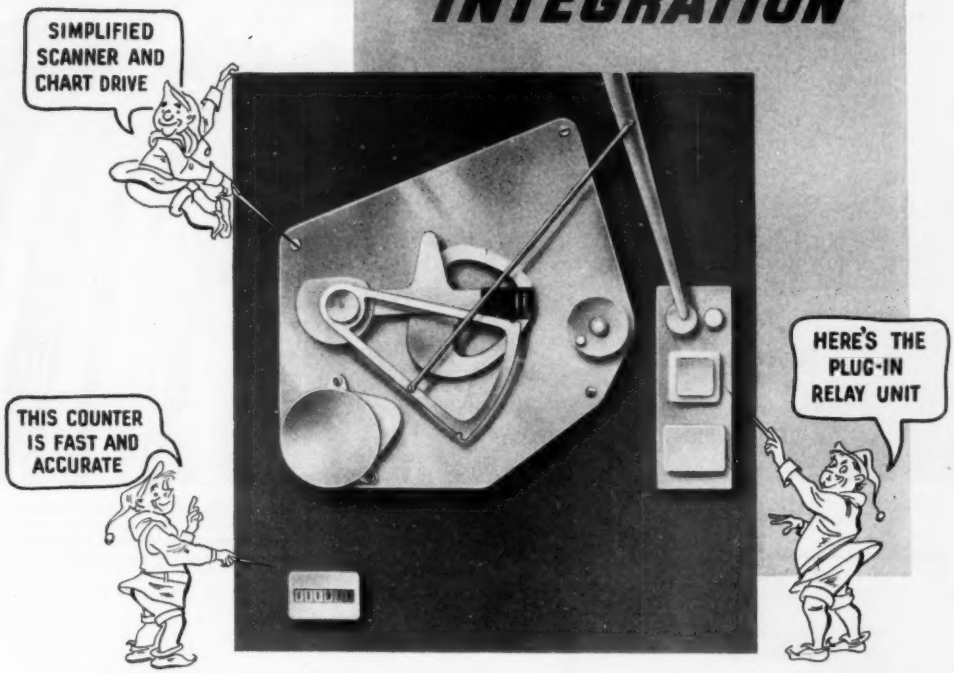
Important Contribution to

The New Brown Electric Flow Meter

EVENLY-DIVIDED CHART . . . provides uniform accuracy for all rates of flow. Write for new *Bulletin No. 293-1.*


CHARACTERIZED BELL IS NON-TILTING
BELL AND BODY ARE CORROSION RESISTANT
FLOW MEASUREMENT IS CONTINUOUS
BROWN ELECTRICAL TRANSMITTER

incorporates . . . ELECTRONIC INTEGRATION



HERE's another important advancement for power and process instrumentation . . . continuous flow measurement, with electronic integration! This Honeywell development eliminates intermittent measurement and slow, complicated totalizing . . . welcome news to process engineers and accountants.

The electronic integrator, consisting of but three major parts, simplifies accessibility and maintenance . . . permits quick checking and calibration. Scanning is rapid and extremely simple. The corrosion resistant meter body is of tubular construction, reducing weight and bulk. Transmission is electric, recorder is fast, chart is easily read under all conditions of flow. The characterized bell is corrosion resistant, too, and is specially designed to eliminate tilting.

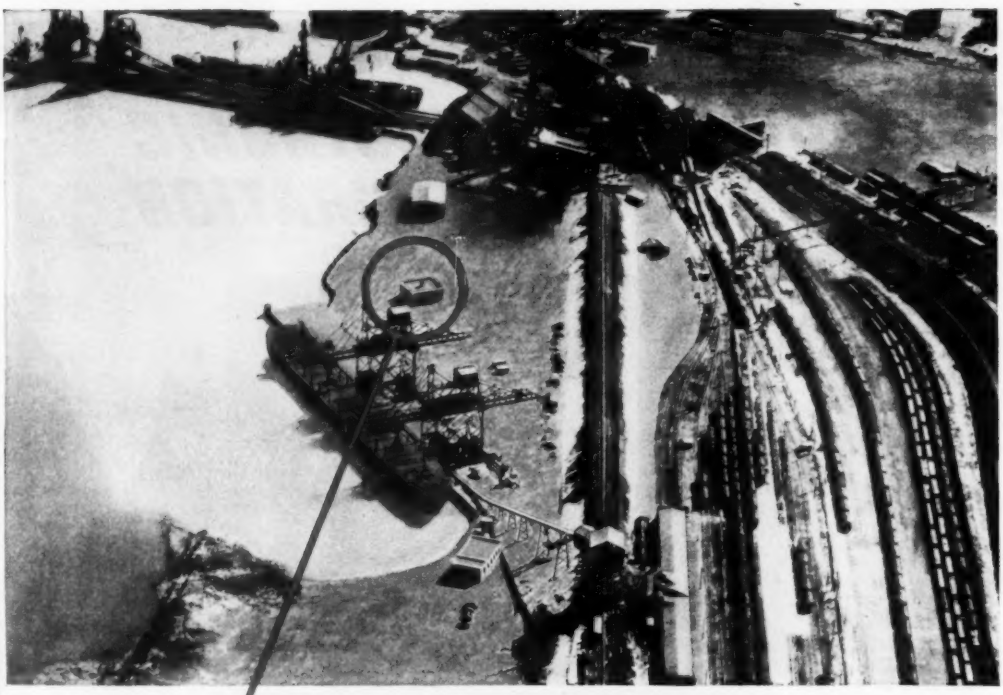
Call in our local engineering representative for a discussion of your application.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

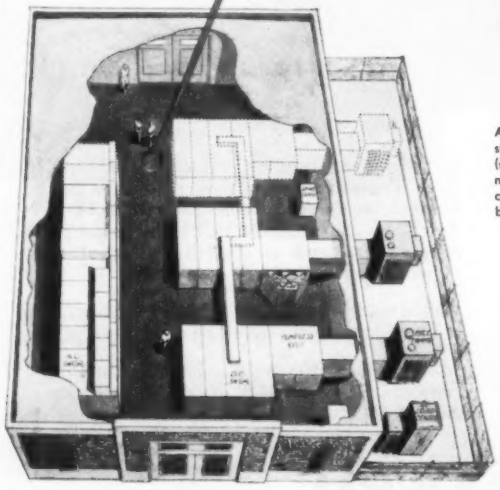
MINNEAPOLIS **Honeywell**

Brown Instruments

G-E switchgear protects operation



Aerial view of the new Baltimore and Ohio ore facility in the Curtis Bay section of the Port of Baltimore. Circled building marks location of the modern G-E substation equipment which supplies power for the two unloaders and two General Electric pusher locomotives that are used to spot gondola cars for loading.



Artist's drawing of the G-E substation showing two 1000 kw d-c substations, a-c substation and metal-clad switchgear. Additional units (sketched in phantom form) show location of the equipment that will be needed for future plans which call for doubling the present unloading capacity. Another d-c load center and two more switchgear units will be needed.

# of new $5,000,000 investment!

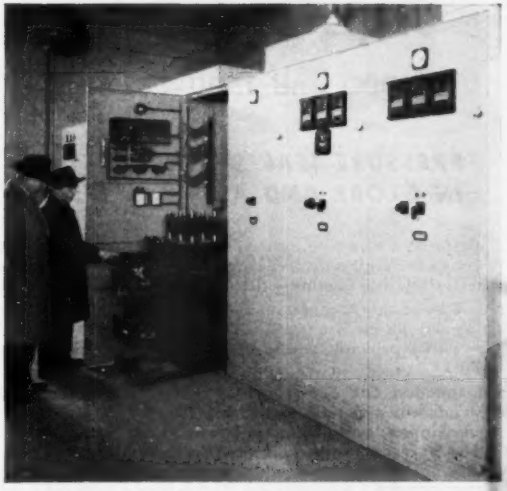
New B&O unloaders move 2000 tons an hour around-the-clock. Continuous power supplied with modern d-c substation and metal-clad switchgear.

Strategic ore from Liberia and South America takes less time to get to the nation's steel producing centers when it is unloaded at the Baltimore and Ohio's new ore facility in the Curtis Bay section of the Port of Baltimore.

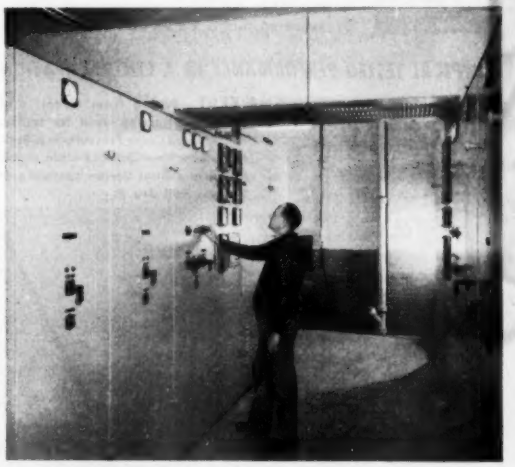
Incorporating the latest improvements in design and equipment, the new ore dock has a working capacity of 2000 tons an hour. The two highly efficient unloaders reduce turn-around time for ore boats and provide an almost continuous stream of ore-laden railroad cars for iron and steel mills. These same cars return to Baltimore loaded with coal, give B & O a two-way pay load for greater efficiency.

Continuous power for 24-hour operation is supplied by modern G-E substations. Two 1000 kw d-c substations supply the main power for the entire installation, while an a-c substation supplies auxiliary power and lighting. G-E metal-clad switchgear provides control and protection for the incoming and outgoing feeders to a-c and d-c load centers.

Forward-looking G-E engineers are ready to apply the knowledge gained from this, and hundreds of other installations, to *your* problems. Investigate today the many advantages of using General Electric switchgear in your plant for efficient, flexible power distribution. Contact your G-E sales representative, or write for bulletin GEA-3083 Metal-clad switchgear. General Electric Company, Schenectady 5, N. Y.



G-E metal-clad switchgear for the 13.2 kv feeders to a-c and d-c substations. All components are metal-enclosed for protection to personnel. Because units are factory-built and arrive ready to install, total installed cost is greatly reduced.



View of the operating aisle of the d-c substation. New G-E pumpless rectifiers provide continuous low-cost d-c power conversion. Minimum number of moving parts reduces maintenance. All parts are easily accessible.

GENERAL ELECTRIC

854-38

Better Steam Flow with Crane Stop-Check Valves

900 and 1500-Pound

PRESSURE-SEAL BONNET DESIGN IN GLOBE AND ANGLE PATTERNS

Performance on your boilers is a *known quantity* with these valves—scientifically predetermined by Crane. Conclusive tests show they operate with lowest possible pressure drop.

Better steam flow is assured by smoother, non-restricting interior design, combined with the exclusive Crane *aspirator-action* principle which provides faster and higher disc lift.

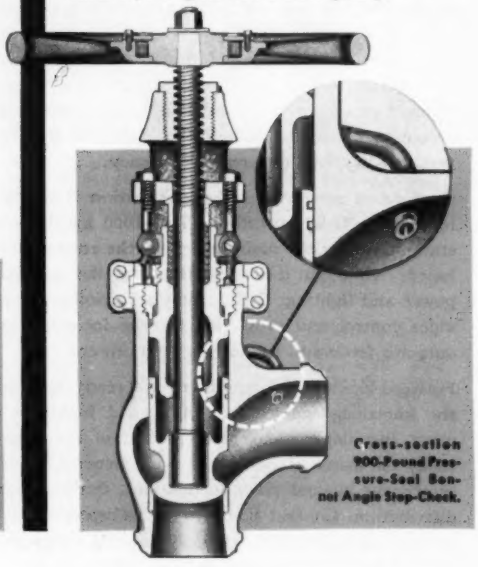
Inspection and Servicing No Problem—No long-time shutdowns with these Crane Stop-Checks! Simplified construction reduces inspection and servicing to a minimum. The most compact in their class, Crane Stop-Checks can be taken down and reassembled easily and quickly, without special tools. For example, unbolting the yoke clamp provides free access to pressure-seal assembly.

As proved in actual service, the Crane Pressure-Seal Bonnet design is the most dependable for high temperature—high pressure stop-check valves.

Crane Y-Pattern Globe Stop-Check with Butt-Welding Ends. In 900 and 1500-Pound pressure classes; for temperatures up to 1000 deg. F. max. Sizes: 6 to 12-inch.

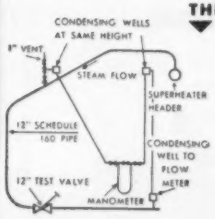
HOW CRANE RAPID-ACTION HIGH-LIFT DISC WORKS

As shown below, a specially designed external pressure-equalizing pipe connects chamber above disc with outlet end of valve body. Under flow, this pipe acts as an aspirator, relieving pressure above disc to permit rapid maximum disc lift. On flow reversal, aspirator pipe admits higher pressure to top of disc chamber, aiding the disc to close quickly.

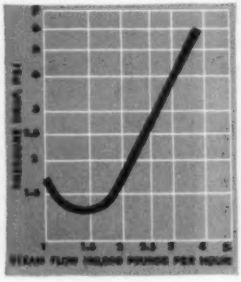


Cross-section 900-Pound Pressure-Seal Bonnet Angle Stop-Check.

TYPICAL TESTED PERFORMANCE IN A CENTRAL STATION



THE TEST—Piping from boiler, and manometer piping used for testing 1500-Pound Crane Pressure-Seal Bonnet Globe Stop-Check in main steam line of a central station operating at 900 psi, 900 deg. F.

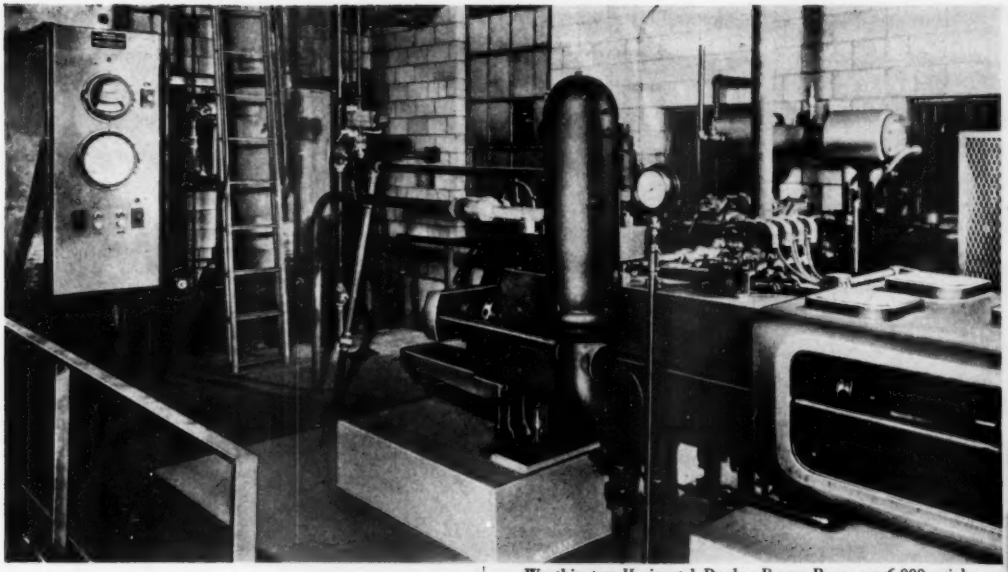


THE RESULT Performance curve shows substantially lower pressure drop than demonstrated by other valves in similar service.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



Worthington Horizontal Duplex Power Pump on 6,000 psi hydraulic system operating forging presses at Erie Forge Co., Erie, Pa.

Team up your Hydraulic Equipment

WITH THE ONE RIGHT PUMP FOR THE JOB

SAVE POWER, SPACE, LABOR

The pump in this picture is the "heart" of a centrally-controlled hydraulic system—powering a number of machines.

With such a system, this plant benefits from: increased overall operating efficiency and economy • concentration of hydraulic operations in a few pieces of equipment • convenient and simplified operation • use of water rather than inflammable or toxic liquid.

Complete Line—of Pumps, of Auxiliaries

The pump is a Worthington. It happens to be a horizontal duplex power pump. On another job, it might have been a high-speed vertical. Or, for larger capacity: a centrifugal pump. Or a steam pump. Or rotary. Whatever kind of pump the job calls for, Worthington *has* the right pump.

That's *one* big advantage in doing business with Worthington—the broadest range of pumps assures you the right one for each job.

Another advantage: Worthington can help you with *other* phases of the installation—for example: selection of proper design and size of high-pressure accumulaters and auxiliaries, system controls such as the Worthington suction valve unloader.

If *you* are planning a new or enlarged hydraulic system, Worthington's unequalled experience in hydraulics plus the wide range of Worthington equipment will help you *beforehand* to plan all these important factors in the installation.

For Descaling, Too

Ask us about the use of Worthington pumps on descaling of billets, sheets, plates, small parts. Descaling saves waste, saves wear on tools, reduces damage to dies in forging, improves the quality of the product.

For further information proving *there's more worth in Worthington* write to Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, N. J.

WORTHINGTON

P.1.2

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

Expanded Tube Joints

The making of expanded tube joints in tube sheets of unfired pressure vessels was discussed in a paper by **F. F. Fisher** and **G. J. Brown,** both of The Detroit Edison Company. The authors reviewed present-day practice of rolling-in such tubes and presented information gained from installing, retubing, testing and repairing many types of heat-exchangers.

They recommended that the optimum degree of expanding be determined by tests conducted in advance of actual rolling operations and that the information so obtained be recorded and made available to others. Preference is given to the automatic relay-operated technique for uniform tube rolling.

As to the finish to be given tube holes, it was pointed out that rolled joints are primarily friction joints and that their holding strength depends upon the pressure and roughness between the contacting surfaces. On the other hand, pressure tightness is best obtained by use of smooth contact surfaces. For example, relatively rough tube holes can be used in heat-exchanger work if the tubes are much softer than the tube sheet. But if the tube material is hard, greater movement is produced between the contacting surfaces, and the axial flow of tube metal may shear or smooth off any roughness of the tube hole. For this reason the tube holes in boiler construction are reamed cylindrical and smooth and the reinforcing grooves are placed near the zone of minimum movement of the tube metal.

In order to bring out the full strength of a joint without undue distortion or damage to the tube sheets and headers, the tube metal should be softer than that of the tube sheets or headers.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
224 EAST 131st STREET • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

What the experts demand...

ELECTRUNITE

PRESSURE TUBES *Provide!*

When power engineers describe the qualities they want in pressure tubes, it all adds up to a description of ELECTRUNITE Tubes. Look, for example, at the list of desirable properties abstracted from the paper delivered by F. F. Fisher and G. J. Brown, of Detroit Edison Company, at the Seventy-first Annual ASME meeting in New York . . .

PROVED — Over 250 million feet of ELECTRUNITE Pressure Tubes are in service in boilers, heat exchangers and condensers of all sizes, output, and types. Republic's research and experience assure you of field-proved tubes for every requirement.

SMOOTHNESS — Tube contact surfaces are smooth and free from rolled-in scale and scale pits. Because ELECTRUNITE Pressure Tubes fit tube-sheet holes accurately, they roll in tight every time.

DUCTILITY — No other pressure tube can give you more ductile properties than ELECTRUNITE Tubes. They bend smoothly and uniformly to permit rapid fabrication and trouble-free erection. They are easy to roll-in, and provide maximum tightness in the tube sheets.

UNIFORMITY — ELECTRUNITE Pressure Tubes are uniform in grain structure, have predictable rolling-in characteristics . . . no slivers, hard spots, or scabs to cause costly delays. Wall thicknesses are uniform, tubes are fully concentric, tube strength is uniformly high.

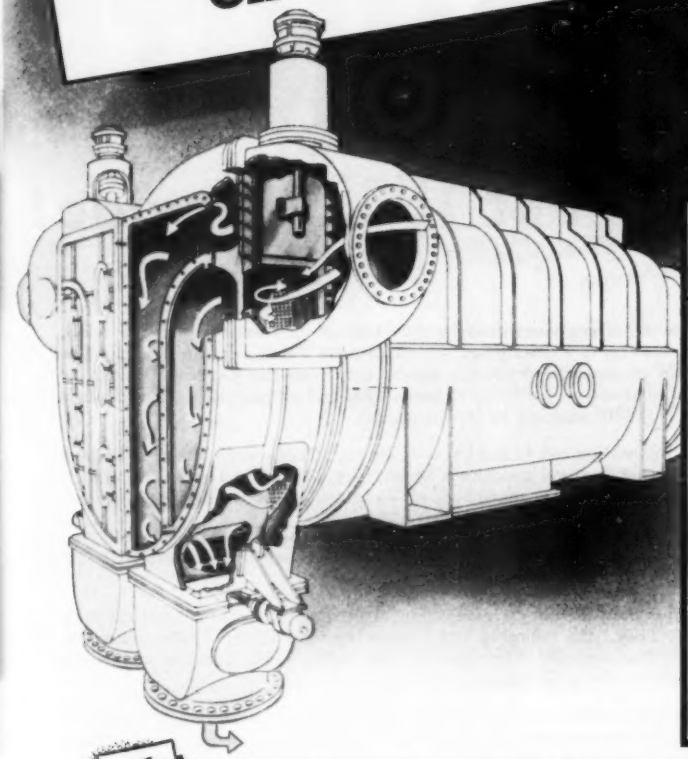
Let us send you a copy of Bulletin BT-12 . . . it describes ELECTRUNITE Pressure Tubes for boilers and process equipment.

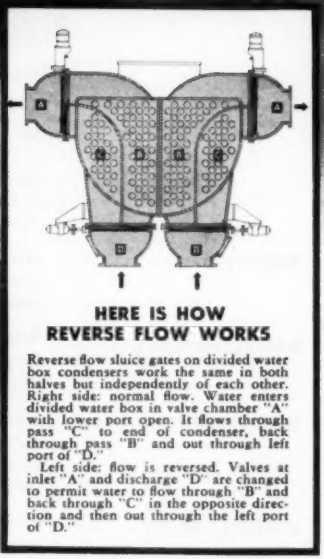
Republic ELECTRUNITE

REPUBLIC STEEL

BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Here's a 3-WAY "ASSIST" On Your Power Plant Problems





HERE IS HOW REVERSE FLOW WORKS

Reverse flow sluice gates on divided water box condensers work the same in both halves but independently of each other. Right side: normal flow. Water enters divided water box in valve chamber "A" with lower port open. It flows through pass "C" to end of condenser, back through pass "B" and out through left port of "D."

Left side: flow is reversed. Valves at inlet "A" and discharge "D" are changed to permit water to flow through "B" and back through "C" in the opposite direction and then out through the left port of "D."

1 CLEAN DEBRIS FROM CONDENSER TUBE SHEETS WITHOUT DOWNTIME OR LOSS OF VACUUM

C. H. Wheeler "Reverse Flow" Condenser design provides a powerful self-cleaning flushing force by the simple procedure of reversing the flow of water through the tubes. Electrically or hydraulically controlled sluice gates accomplish in minutes cleaning that consumes hours of downtime when removal of debris is done by hand. Power plant modernization calls for the efficiency and uninterrupted operation of C. H. Wheeler "Reverse Flow" Condensers. You don't need costly water straining apparatus. Send for latest bulletin #410.

STEAM CONDENSERS–STEAM JET EJECTORS–COOLING TOWERS–VACUUM REFRIGERATION–HIGH VACUUM EQUIPMENT

2 VACUUM PUMPS WITH LOWEST MAINTENANCE FOR YOUR STEAM CONDENSERS

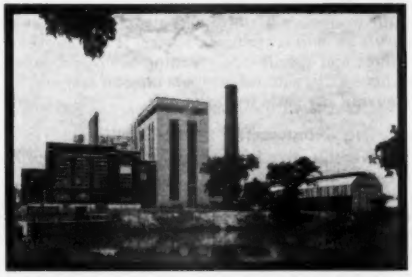
C. H. Wheeler Steam Jet Ejectors are the development of 35 years of pioneering in this field. Known as "Tubejets," these vacuum pumps have no moving parts. Hence, they are simple to operate, require almost no maintenance and last longer. Modern Power plants use single or two-stage Tubejets with surface inter-after condenser for the vacuum requirements of steam condensers. Special arrangements of standard Wheeler ejector assemblies can be provided for any unusual installation or performance requirements. Catalog #1462 gives you detailed descriptions and some useful temperature and pressure conversion tables. Write for it.

SPECIAL TYPE TUBEJET VACUUM PUMP FOR HIGH PRESSURE AND HIGH SUPERHEAT

3 COOLING TOWERS THAT MEET GUARANTEED PERFORMANCE FOR CHILLING CONDENSER WATER

With C. H. Wheeler Steam Condensers and C. H. Wheeler Tubejet Vacuum Pumps, the up-to-date power plant completes its quest for greater efficiency and economy of operation with the erection of one or more C. H. Wheeler Cooling Towers.

The finest California Redwood goes into the timbers, filler and casing of C. H. Wheeler towers with no stinting on thickness or footage. Built to withstand hurricane winds up to 100 mph, with guaranteed water cooling performance, including guaranteed air delivery for all fans. Each tower is specifically engineered for your job and custom built to assure you satisfactory service for generations to come. Various methods of sheathing and design provide good architectural harmony where desired. Write for the name of your nearest C. H. Wheeler representative.

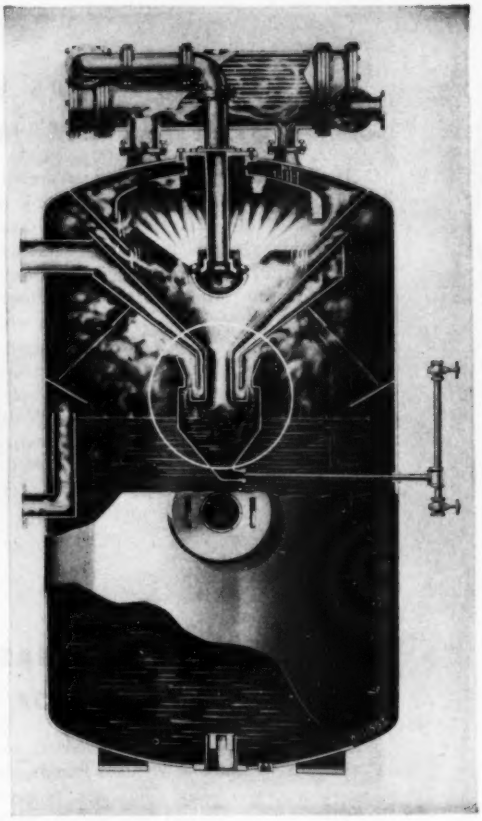


C. H. WHEELER COOLING TOWER AT MISSION ROAD POWER PLANT, San Antonio, Texas

C. H. WHEELER MANUFACTURING CO.
1800 Sedgley Avenue, Philadelphia 32, Pa.
Representatives in most principal cities

C.H. Wheeler OF PHILADELPHIA

—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS AND EJECTORS—DECK MACHINERY



Hard scale, formed on the trays of deaerating evaporator preheaters, is no longer the big problem it used to be.

In a large central station (name on request), the preheaters had to be cleaned every three weeks, and the units were completely shut down at that time from eight to ten hours.

Then Worthington steam-jet deaerators were installed—with a "blowdown" head designed by Worthington engineers. This special head allows the operator to remove harmful deposits at regular intervals *while the unit continues in service.* It also provides for simple and speedy acid cleaning of critical parts, when necessary, without even opening an access door or removing any parts from the unit.

Compare The "Time-Outs"

The Worthington unit, given a short blowdown once each shift, stays in continuous operation with maximum deaeration for periods of at least 8 months. When the acid treatment is given at the end of that period, the job is finished in under three hours.

Compare this with the former record. *Then*—8 to 10 hours outage every three weeks and labor by a *crew* of men. Now—with Worthington's blowdown head—operation uninterrupted during regular short blowdown, with a shutdown for acid cleaning only once in almost a year, requiring only one man and three hours!

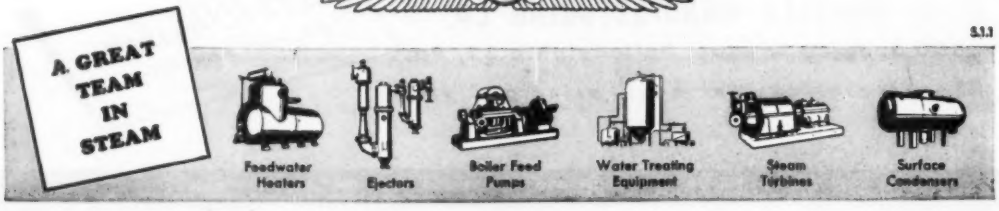
Worthington Makes Deaerating Equipment News

Developments like this, applicable to any deaerators operating under conditions of scaling, are typical of Worthington's engineering firsts in water treating and deaerating equipment.

Worthington manufactures all of the equipment needed in a complete water treating installation. For further information on why *there's more worth in Worthington*, address Worthington Pump and Machinery Corporation, Steam Power Div., Harrison, N.J.

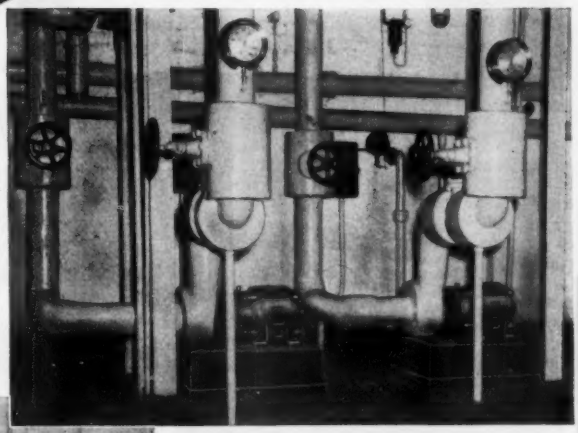
WORTHINGTON

S-3.1



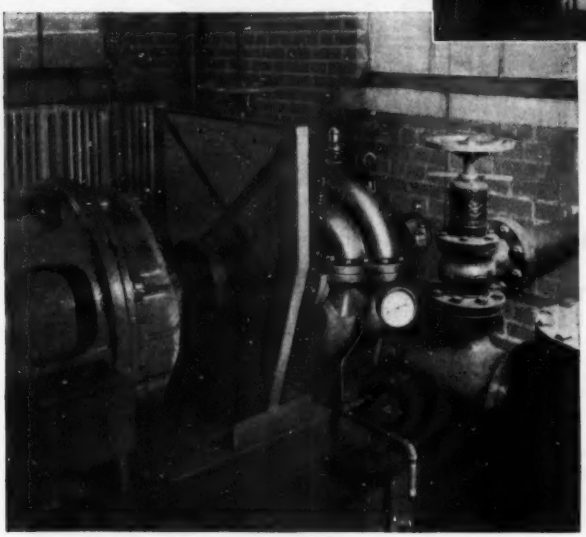
2 TYPES OF "Buffalo" PUMPS

FOR EFFICIENCY ON YOUR CLEAR WATER JOBS!



CLOSE-COUPLED! SPACE-SAVING!

. . . and ruggedly built to stand severe service, as in this installation of two "Buffalo" Close-Coupled Pumps handling chilled water. Close-coupled construction, with impeller overhung on motor shaft, means permanent alignment. These compact single suction pumps with flanged openings can be installed vertically or horizontally. BULLETIN 975-B, completely describing "Buffalo" Close-Coupled Pumps, will be mailed to you on request.



WHEN YOU WANT HIGH VOLUME IT'S "SL"

. . . "Buffalo" Double-Suction Type "SL" Pumps are of the finest obtainable construction, hydraulically balanced, and built in sizes to handle up to 10,000 gpm at heads up to 350 feet. Here are the pumps specified for the large air conditioning jobs, and for all continuous-service clear water applications. You can install "SL" Pumps with every expectation of peak efficiency, long, dependable service and inexpensive maintenance. It will pay you to look into these fine pumps—write for BULLETIN 955-N.

NOTE: "Buffalo" also manufactures a full line of fans, unit heaters, air washers and air conditioning units for any air handling application you may have. Complete information on request.

"Buffalo" PUMPS

BUFFALO PUMPS INC.

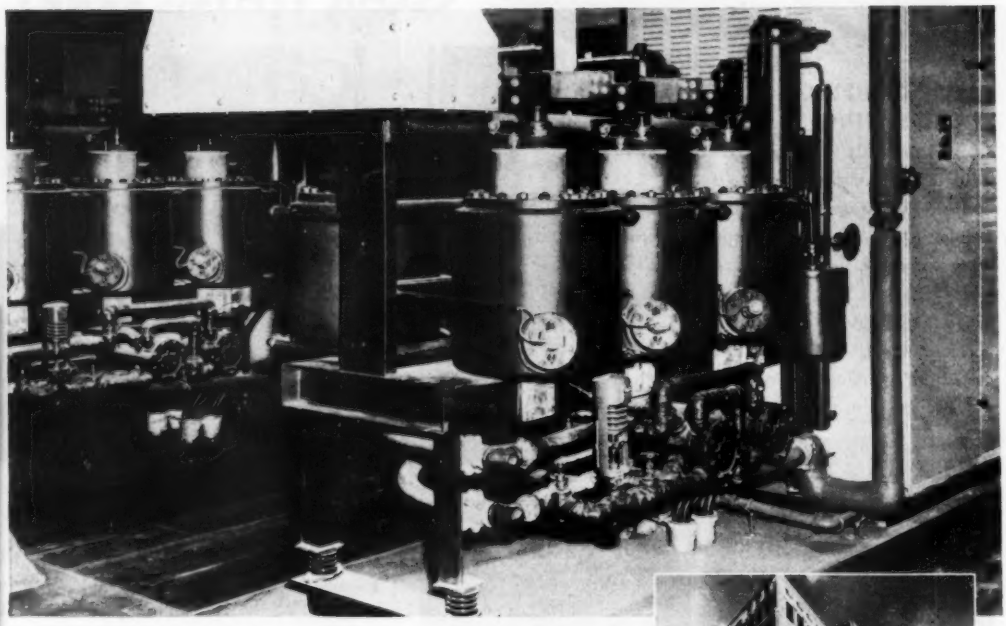
488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

World's Largest Store uses 5000-kw Rectifier Installation



Macy's replaces d-c generating plant with G-E IGNITRON RECTIFIERS

When this famous New York store decided to discard its d-c generating plant and buy power, it had a problem. A considerable portion of its equipment required d-c power but only a-c power could be bought. After considering various methods of power conversion, Macy's chose dependable, proved-in-service G-E Ignitron Rectifiers to supply the 5000 kw of d-c capacity it needed.

The G-E Ignitron Rectifiers operate 24 hours a day, 7 days a week, with minimum attention. In addition, it gives steadier, constant voltage over the entire load range and higher short-time overload capacity. Supplied as a complete packaged unit with transformer and metal-enclosed switchgear, the installation occupies minimum space.

For information on a G-E Ignitron Rectifier to fit your d-c power needs, ask your nearest G-E Sales office for a copy of bulletins GEA-5539 and GEA-5569 or write General Electric Company, Schenectady 5, N.Y.

Major portion of the power load of this huge store is supplied by the 5000 kw G-E Ignitron Rectifier installation.

124-1

GENERAL ELECTRIC

Power
COMBINED WITH OPERATING ENGINEER

How About Some Scrap?

WE ARE LOSING the race for scrap iron and steel to keep the defense program rolling. So please look around your power bailiwick and any other departments where you have influence. Can you dig up a few tons for Uncle Sam?

The kind and amount of scrap he needs won't come from one of those "patriotic" drives where housewives go from door to door collecting bobby pins and bird cages. As practical men you know that most of it must come from industry through the initiative of responsible industrial managers, including yourselves.

Here are a few facts: Traditionally this is the time of year when the steel industry stores up scrap for the winter. Yet right now the furnaces are melting more than comes in, so scrap piles are dwindling at a time when stocks are down to twenty days. Sixty is safe.

This business of turning out two million ingot tons of steel every week, week after week, is a strictly American show. No other nation could touch it. Even our enormous steel industry couldn't do it from pig iron alone—not by a long shot. Fact is, steel makers have boosted the percentage of purchased scrap (that's not counting steel-mill scrap) charged to furnaces from last year's 24% to a new high of 28%. This percentage will surely slump fast unless scrap collections from industry pick up at once. Here, then, is a chance to help.

There are two kinds of heavy industrial scrap. "Dormant scrap" comes from obsolete machinery sitting around waiting for somebody to make up his mind to junk it. That's the kind most likely to be hiding in your department. Look around. What about those big hunks of dead steel and cast iron—obsolete equipment that has been lying idle for years, "just in case" you might find some use for it? Have you been kidding yourself about it ever being used again? If so, now's the time to turn it into guns.

The second kind of heavy industrial scrap is "production scrap." Cutting up steel in production departments may not be a power function, but your power department's example (with a little local publicity) may set others to work turning in scrap by the hundreds of tons.

Speaking of good examples, we have two to offer. In three months Eastman Kodak found 88 carloads of dormant scrap lying around the works. That's good for a lot of military hardware. And very likely cleaning out this junk improved working conditions at Kodak.

The Hartford, Conn., plant of Pratt-Whitney has 250 men assigned to the job of collecting scrap. They sell a million dollars worth a year. Don't worry about that 250 figure, but how about one man in the power department (maybe the power engineer, himself) spotting junk and running up a tonnage score right now?

Phil Swain

THESE EDWARD DESIGN FEATURES

ALL ARE "FIRSTS"... MANY ARE "EXCLUSIVES" ...EACH MEANS A BETTER VALVE

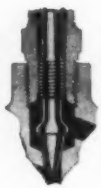
INCLINED STEM VALVES First to build inclined stem forged globe stop valves and check valves. Edward construction eliminates turbulence, cuts wear, reduces pressure drop 25 to 50 per cent.

RADIUS STEM HEADS Radius of stem head assures application of closing load at center of disk. Curvature of inside of disk, in contact with stem head, centers disk for sure, tight seating.

FOOLPROOF STEM BACKSEATS Spherical stem or disk nut surface contacts taper bonnet surface to make a pressure-tight backseat. Exclusive with Edward.

UNIVALVE* BONNET JOINT Patented leak-proof welded body-bonnet joint assures perfect alignment of working parts, pirmits disassembly if ever necessary.

EVALIZING* Exclusive Edward process electroplates parts with wear-resistant metallic lubricous material. Reduces wear and friction between internal valve parts 50 per cent or more. Ideal for temperature service.



TAPER THREAD BONNET JOINT Taper threaded joint in small forged gage valves gives tight seal, withstands extreme pressures.

CROSS ARM IMPACTOR* HANDWHEEL Now the famous Edward Impactor principle is applied to small valves. Easy-to-grip cross-bar delivers 2.8 times the closing load of ordinary handwheels. No wrenches or extensions needed.

FORGED STEEL FLANGED VALVE DESIGN Edward designed first forged valves with symmetrical, uniform wall thickness. Eliminates thermal distortion and stress, cuts needless weight.

SWING BOLT RETAINER New type retainers keep packing gland swing bolts in place on integral forged support pins, yet out of way for easy repacking.

NO-BONNET INSTRUMENT VALVE No chance for bonnet joint leak with these compact all forged valves for toughest instrument line service.

WELDED-ON FLANGES Edward patented first valve constructions using welded flanges. Permits super strong drop forged bodies with thin walls and proper fibre flow.

EVALPAK* PACKING Edward developed first asbestos-graphite packing with special processing to prevent stem pitting. Die molded, wire supported, low operating torque.

OTHER EDWARD FIRSTS! **Patented EValthrust* yoke bushings . . . Impactor* handwheels . . . Closure indicators . . . Low pressure loss cast steel body contours . . . Three-point disk guiding . . . Self-centering disk throttling lip . . . Free floating tubular disk-piston . . . Edward Equalizer* . . . Edward pressure-seal design . . . Intex* integral seats . . . Seat-located guide ribs in gate valves . . . Hour-glass type disk-piston . . . Separated feedline stop-check valves . . . Patented interchangeability of stop, check and non-return valves.**

Registered trade name of Edward Valves, Inc.

assure top FORGED STEEL VALVE VALUE

DON'T SETTLE FOR LESS!

Forged Steel valves, because they are small, sometimes don't get the attention they deserve when specifications are drawn.

But the smallest valves, if not equal to the service to which subjected, may be the most troublesome. Therefore, it pays to take the time to analyze design features and to study actual service records.

If you do, you'll find that Edward forged steel valves are the most copied in the field. You'll find that dozens of features that were Edward "firsts" are now accepted as industry standards. But you'll also find that there are still many patented features exclusive with Edward.

Edward pioneered *forged steel* valve construction, and Edward design developments have consistently been a step ahead of mounting service requirements, piling up outstanding service records in some of America's most famous power plants and process installations.

Don't discount experience. For steel valves for pressures from 150 to 7500 lb, expect the best *first* from Edward.

Edward

New design Fig. 444-448 series *all forged steel* globe and angle valves, 600 and 1500 lb sp, bolted or union bonnets, screwed or welding ends. Fig. 444 illustrated.

Edward

***All forged steel* welded bonnet Univalves®, 1500 and 2500 lb sp. Integral Stellited seat, Stellited disk, chrome-moly bodies, with permanent or removable backseats for disassembly in the line. Fig. 2224 illustrated.**

Another Product

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

EDWARD VALVES, INC.
1220 West 144th Street, East Chicago, Indiana

Please send me Bulletins describing Edward forged and cast steel valves.

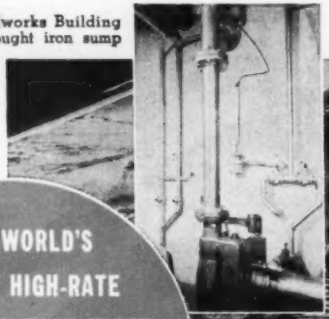
NAME_____

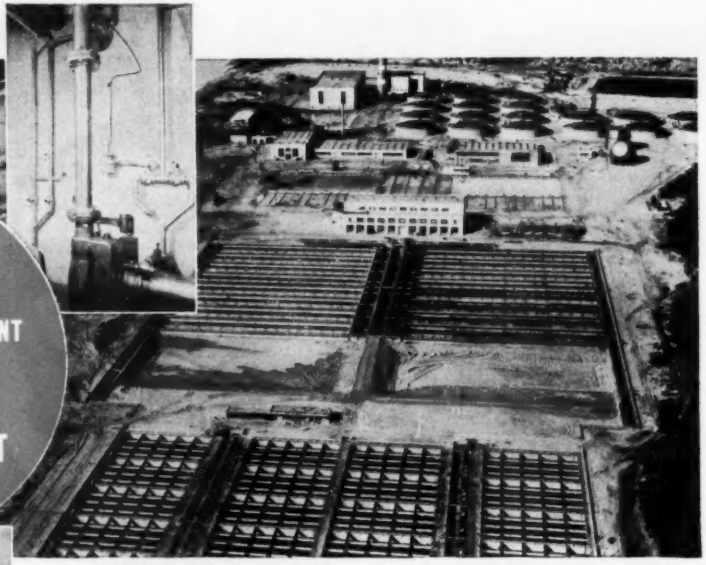
Street_____ Zone____ State_____

City_____

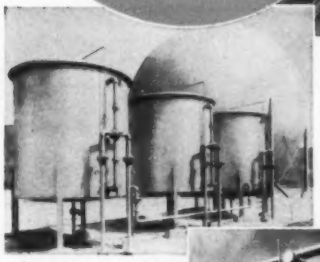
☐ Have Edward representative call.

Pump room in Headworks Building showing genuine wrought iron sump pump and grit pump discharge pipe, and effluent wash water lines.

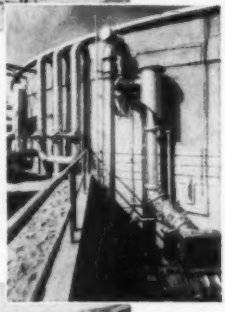




In the WORLD'S LARGEST HIGH-RATE ACTIVATED SLUDGE PLANT 51 INDIVIDUAL SERVICES ARE BYERS WROUGHT IRON



Showing genuine wrought iron water, gas and air lines leading into gas purifier.



Showing genuine wrought iron vents, water, effluent, and gas manometer lines on one of the 18 digester tanks.

Showing genuine wrought iron weir plates in final settling tanks at sludge plant.

Covering 76 acres, this $41,000,000.00 Hyperion sewage treatment plant of the City of Los Angeles is the world's largest treatment works using high-rate activated sludge process combined with sludge digestion, power generation, and fertilizer production.

In the design and work planning, engineers under Lloyd Aldrich, City Engineer, took decisive steps to forestall excessive maintenance and premature failure by specifying genuine wrought iron for 51 individual services where corrosion is a threat to durability. In the Primary Settling System, Digestion System, Power and Boiler Plant, Aeration System, General Piping System, Final Settling System, Elutriation System, and Ocean Outfall Sewer, genuine wrought iron safeguards a wide range of services against corrosion hazards. More than 141 tons of Byers Wrought Iron was used in fresh water lines, sump pump discharge lines, weir plates, condensate piping, instrument air piping, down spouts, flushing lines, air lines, underground piping, bearing plates, and many other services too numerous to list. Metcalf & Eddy of Boston were Consulting Sanitary Engineers; Merrill Butler, Deputy Engineer in charge of design; E. G. Studley, Engineer of Sewer Design; C. L. Bell, Projects Coordinating Engineer; G. A. Parkes, Senior Treatment Plant Design Engineer; and F. M. Darnell, Senior Administrative Engineer. The plant is being operated by the Bureau of Engineering.

The unique structure and composition of Byers Wrought Iron provides the needed service qualities for these punishing applications. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and "detour" corrosive attack. They also help anchor the initial protective scale, which shields the underlying metal.

Our bulletin, WROUGHT IRON FOR SEWAGE TREATMENT AND DISPOSAL INSTALLATIONS, gives some helpful information on how to reduce repairs and maintenance. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

THEN →

These steam-engine soldiers turned the 7500-kw 25-cycle generators pumping power to New York's subways. They're still working alongside new 50,000-kw turbine-generator

Standing atop one of half-century-old units, Hamilton glances over changing power scene. He lived with plant, watched it develop from day first unit started turning

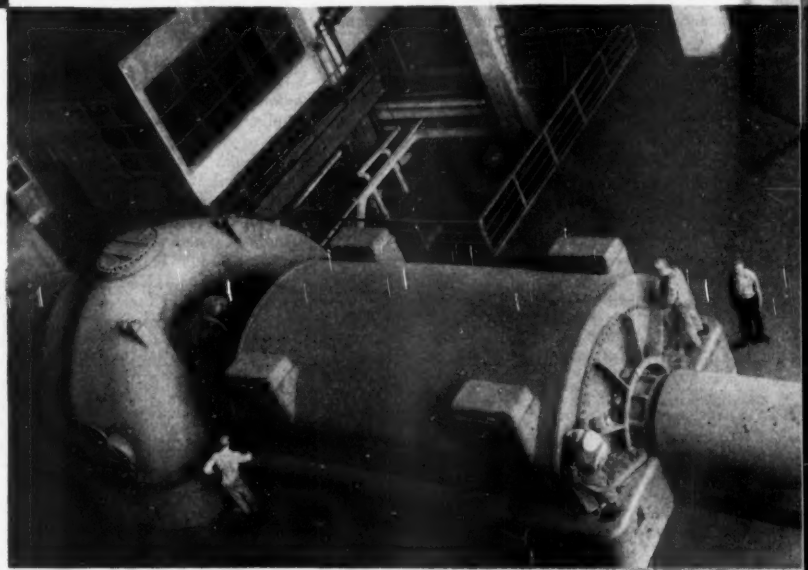
"I Saw 50 Years of Progress...

. . . right here at the New York subway system's 59th St Station" says John Hamilton* "and you can see it too." To bring alive this picture of 1902 power practice side-by-side with today's John recalls from his memories a tour of yesterday's plant to go with *Power*'s report on its new extension. Let's go . . .

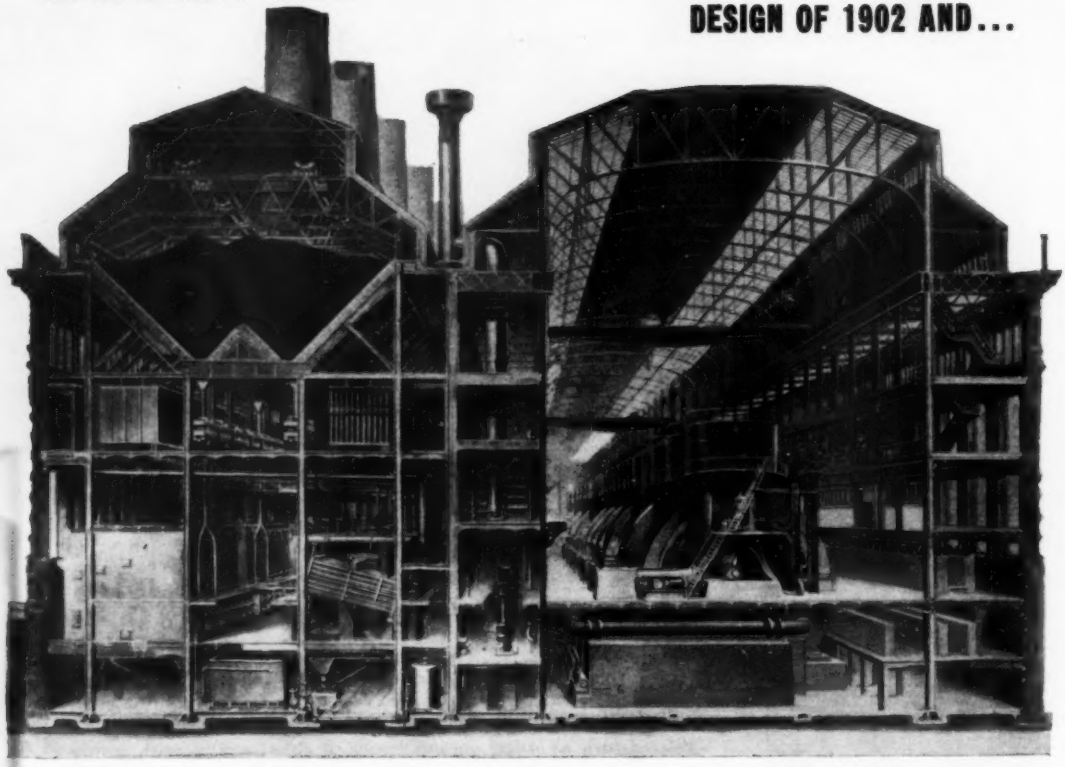
*Supervisor of Electrical Power (retired), NYC Board of Transportation

NOW →

Hydrogen-cooled generator powered by 1250-psi turbine stands in sharp contrast to bygone power era pictured above. A 600,000-lb-per-hr boiler supplies 950-F steam



DESIGN OF 1902 AND...



SECTION A-A (see sketch top of facing page): Boilers and engines were grouped into five unit areas—12 boilers and 2 engines in each. The plant now has 64 boilers in the old area. Generators, originally rated 5000 kw, now rerated to 7500 kw

► "SHE WAS THE LAST WORD in power-plant design. From her ornate, French Renaissance building facework to the nine compound steam engines that stand 35 ft from the operating floor, she was an engineering model when final plans were completed in early 1902. And time has proved the soundness of that early design. The old plant will soon round out fifty years of steady operation, still going strong." So says John Hamilton, retired supervisor, who watched over the 59th St Station of New York's subway system from the day she started.

Plant Tour. "As I look back over the past half century I can clearly recall time and again showing groups of visiting engineers through our then modern plant. So let's roll back the curtain of time and join such a group as they start a tour of the plant . . . they're assembled on the corner of Eleventh Ave and 59th St, New York City, around the year 1905.

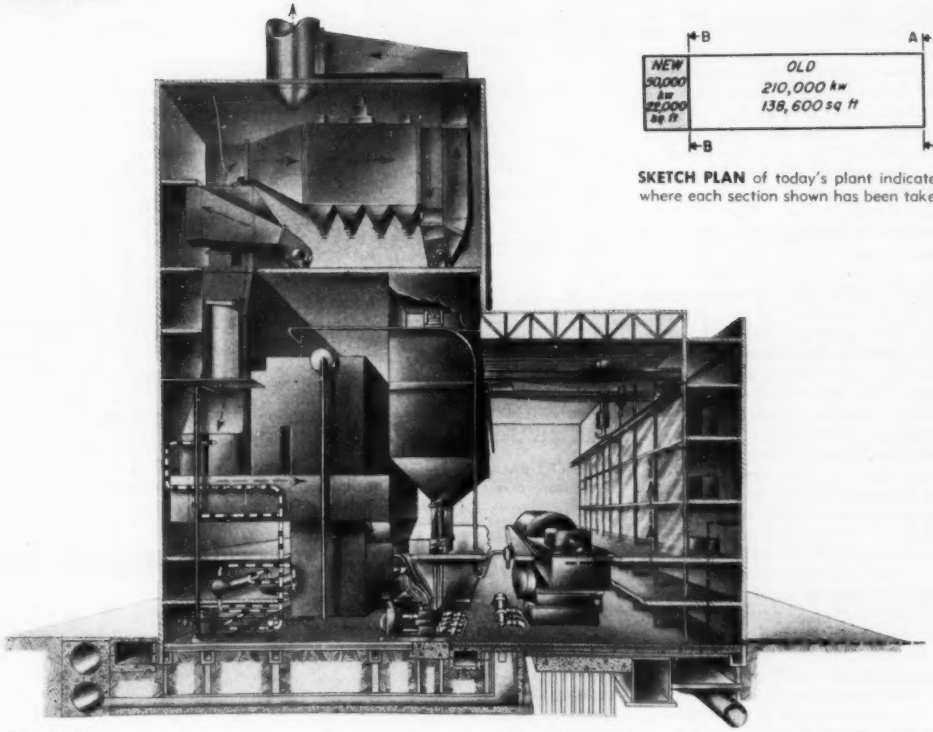
"Stanford White, of the firm of McKim, Mead & White, New York, acted as building-design consultant. Granite, light-colored brick and terra cotta are woven into an elaborate architectural treatment. Five chimneys, spaced 108 ft apart on the long central line of the boiler room, reach into the sky 225 ft above the boiler grating.

Coal Handling. "By skirting along the outside of plant and walking a block or so we come to the Hudson River. Starting at this point we can 'follow through' from coal pile to station bus. Coal is handled by a movable electric hoisting tower with crushing and weighing apparatus, plus a system of horizontal belt conveyors. The 30-in belts carry crushed and weighed coal along the dock and then through an underground tunnel. At the tunnel's end conveyors are used once again to lift coal 110 ft to top of boiler house. They can handle 250 tons of coal per hour. A 20-in belt conveyor then takes over to distribute coal over coal bunkers. Coal from bunkers flows down to the boiler room through downtakes on each side of central firing aisle.

"Ash goes out in cars running on a system of 24-in.-gage tracks under the ash-hopper gates in boiler-house cellar. They tie into an elevated storage bunker at water front. Rolling stock on this miniature railroad consists of 24 steel cars, each with a 2-ton capacity. Cars have gabled bottoms and side-dumping doors. An electric storage-battery locomotive does the hauling. Cars deliver ash to an elevating belt conveyor that fills the 1000-ton ash bunker.

Boilers. "Main boiler room is designed to receive ultimately 72 safety watertube 3-drum boilers, each having 6,008 sq ft of effective heating surface. Now there are 52 boilers erected in pairs (it's 1905, remember?—*Ed.*) Between each pair of boilers is a 5-ft passageway. Boilers are designed for a working steam pressure of 225 psi and a hydraulic test pressure of 300 psi. Each has 21 vertical water-tube sections, and each section is 14 tubes high. Tubes

...TODAY



SKETCH PLAN of today's plant indicates where each section shown has been taken

SECTION B-B (see small sketch above): New extension houses modern unit-boiler-turbine installation. Generated 25-cycle ties-in to local utility 60-cycle through frequency changer. Air-blast circuit breakers are used on all the 11-kv circuits

are lap-welded charcoal iron, 4 in. dia and 18 ft long. Drums are 42 in. dia and 23 ft, 10 in. long. Shell plates are 9/16 in. thick, and the drum head plates 11/16 in. Note that thickness is slightly greater than standard practice (1905 again.—*Ed.*).

"In setting boilers, several tricks were used that are new in boiler erection. For instance boilers are set higher from floor than in standard practice; drum centers being 19 ft above floor line. This means a higher combustion chamber for either hand-fired grates or automatic stokers.

"Following European practice, each boiler has two water columns, one on each outside drum. Likewise, each boiler has one steam gage above the platform for the water tenders and one below for the firemen. We are planning to use superheaters in the entire boiler plant.

"To burn fine grades of anthracite coal and get boiler rating with hand-fired grates, a system of blowers and air ducts is installed under boilers. One blower handles three boilers. It can also supply all six boilers in a unit, if need be. Each blower is 11 ft high above floor and 5 ft, 6 in. wide at floor line. Each is direct-connected to a compound steam engine. This unit will provide enough air to burn 10,000 lb of coal per hr.

Steam Piping. "Six boilers feeding one main engine can be handled as a unit. Risers, with 9-in. wrought-iron goosenecks, connect each boiler to a 17-in. steam main. At that point a 9-in. angle valve is inserted in each boiler connection. Main line from the 6-boiler unit is carried directly across the boiler-house, connecting to two 14-in. steam down takes feeding engine throttle. At this point, the steam can also be led down to a manifold to which compensating tie lines connect. These compensating lines run lengthwise through the power-house tying the steam systems together.

"There's a quick-closing valve where the 17-in. main line divides into the two 14-in. downtakes. Similar valve is located where main connects to manifold. First valve will control steam to engine and second controls steam to and from manifold. Piping area with its valves, together with manifolds and compensating pipes, is divided by cross-walls into sections. Each section corresponds to each pair of main engines.

Water Piping. "Fresh water enters the building at three points; largest water service is a 12-in. line. Water first passes through fish traps, meters, then to main reservoir tanks. Water is heated in reservoir tanks by hot-water discharge from high-pressure steam traps. Then water goes to feed pumps and to feedwater heaters, where it is further heated by exhaust from condenser and feedwater pumps. Water then goes direct to boilers or through economizer system to be further heated by waste furnace gas.

Engines and Turbines. "There are nine main engines, each direct-con-

nected to a 5,000-kw generator. In addition, three steam turbines power two 1250-kw lighting generators. Two 250-kw exciter generators are run by 400-hp engines.

"Main engines are two-component h-p and l-p compound engines, both connected to a common shaft. Generator is placed between high- and low-pressure section. H-p cylinders are 42-in. dia; l-p measure 86 in. Poppet-type valves are used in h-p side, corliss valves in l-p.

"Unit for lighting load consists of two turbines tandem-compound. Each has an output of 1250 kw with throttle pressure at 175 psi and exhausting to 27 in. Hg. At full load, unit will take 15.7 lb of steam per electrical hp. hr.

Condensing Equipment. "Each engine unit has its own condenser equipment. This means two barometric condensing chambers attached close to its respective l-p cylinder. Each engine also has a vertical circulating pump along with a vacuum pump. Circulating pumps are vertical, cross-compound pumping engines with outside-packed plungers. Each pump has a normal capacity of 10,000,000 gal of water per day; total pumping capacity for all the pumps is 120,000,000 gal per day. The vertical dry-vacuum pumps are alongside the circulating pumps.

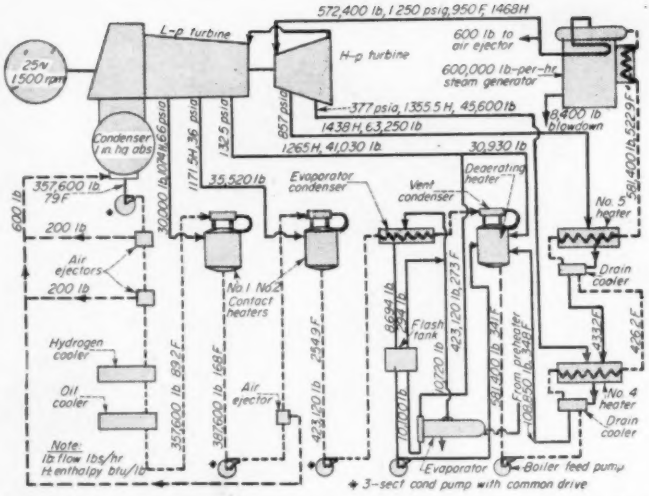
Electrical System. "Electrical power generated at 11 kv, 3 phase, 25 cycle is sent to substations and there rectified to dc. Direct current at about 600 v is fed to third-rail in subways for train operation. At this time (1905) we have nine 5,000-kw generators, each capable of delivering 7500 kw during rush hours. Total weight of each 5,000-kw generator is 889,000 lb. Alternators have 40 field poles and operate at 75 rpm. At full load, the generators have an efficiency of 97%. This figure does not include windage loss and friction.

"Machines are designed to operate under rated full load with a rise of temperature not over 35 C after 24 hr. Fields are supplied at 250 v from five 250-kw dc generators.

Bus Arrangement. "Two complete and independent station buses are used. Each alternator and each feeder may be connected to either of these at the will of the operator. Oil switches are used on each feeder; they can be operated from the highboard.

"Busbars in switch gallery are enclosed in brick compartments. These have small doors for inspection and maintenance. Inspection doors are opposite all points where busbars are supported on insulators."

And so ends our tour through the original plant. Now look at POWER'S *report on the new 50,000 kw addition.*



ROE HEAT BALANCE arrangement has characteristic common drive on three-section condensate pump. Five bleed points off single turbine handle feedwater heating

50,000-KW EXTENSION USES MODERN UNIT . . .

COMING BACK TO THE YEAR 1951 it's interesting to note changes woven into the original design over the past half century. Right now there are 64 boilers in plant's old section. Superheaters and automatic stokers have come into the picture. And in more recent years oil-burning equipment was installed in nine boilers.

Electrical side of the plant has seen its share of the changes too. Rating of engine-driven generators has been upped to 7500 kw. Vertical low-pressure turbines were hooked in on exhaust of first five engines. These drive 7500-kw 4-pole induction generators. The conventional horizontal turbine has bowed in: units 7, 8, and 12 are turbine generators rated 35,000 kw each.

The New Plant. An extension on the plant was anticipated when the original plans were drawn in 1902. Space has been held in reserve since. In building the new extension it was simply a matter of erecting a sleek modern building smack alongside the end of the old plant.

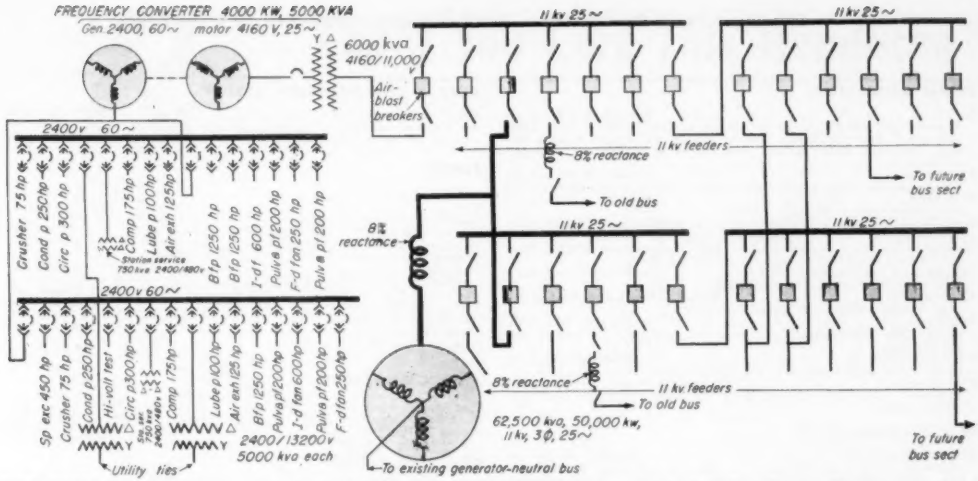
Then when new building was completed structurally, wall between old and new was removed. So you now find under one roof the original steam engines, 35,000-kw turbines, vertical turbines operating on engine exhaust, and the brand-new 50,000-kw unit.

Stepping over the threshold from the old into the new extension is like leafing through the pages of an up-to-the-minute history book. As we enter the new section we see an enclosed air-conditioned electrical control room to the left on machine floor. Here the electrical crew can operate all switchgear and electrical controls from one comfortable point. Boiler control panel is on floor below.

Steam Generation. Boiler seen to the left, looking out from the control room, is capable of burning either coal or oil. It is planned to use oil on an emergency basis. The dry-bottom, radiant boiler has a continuous-tube-type economizer with an undrainable hung superheater. Pulverizers will feed eight burners.

Another in the series of contrasting touches is noted in the air heater with its 197,000 sq ft of heating surface. This unit delivers combustion air at 600 F. Two forced draft fans are motor-driven and vane-controlled. Gases of combustion are handled by two induced-draft fans, motor-driven, using hydraulic couplings for speed control. Combination of one forced-draft and one induced-draft fan will give a flow rate of 430,000 lb of steam per hr. An overall efficiency of 88% is expected from the steam generator. Boiler measures 87 ft high, 52 ft deep, and 38½ ft wide.

High-pressure ends of h-p and l-p cylinders of main turbine face each



ELECTRICAL BUS PLAN keeps all 11-kv feeders at 25 cycles. 60-cycle output feeds 2400-v station-auxiliary buses. Each Bus is metal-enclosed, isolated-phase. Frequency-converter 2400-v bus in turn, taps into local utility co's 60-cycle tie-line

...STEAM PLANT TO POWER 25- AND 60-CYCLE ELECTRICAL BUS SYSTEM

other to hold close wheel clearances. At generator load of 62,480 kw, net heat rate will be 10,674 Btu per kwhr.

Generator. Although the generator will normally produce 25-cycle ac, it can be revamped for possible future operation at 60 cycles. This is by no means a simple job. First off, a new generator rotor will be needed. In addition it will be necessary to change a good portion of the stator winding. In short it involves a change in the number of rotor and stator poles as well as machine speed.

Interrupting Capacity. Calculated short-circuit current at the 11-kv bus is 1,450,000 kva. With this in mind 11-kv air-blast machine breakers were selected on the basis of 1,500,000 kva minimum interrupting rating. The 11-kv feeder breakers, also air-blast type, can interrupt 1,000,000 kva safely. All 2400-v breakers have an interrupting capacity of 500,000 kva.

The question of interrupting capacity posed an important problem since it is necessary to tie in the new 11-kv bus with the existing buswork in the old section of the plant. Naturally the interrupting capacity of the old switchgear is nowhere near the required value. Hence an 8% additional reactance was put in each feeder running between the new and old sections of the high-tension bus. Brick-enclosed bus work in the plant's old section is being replaced at present; running almost plant length.

A modern metal-enclosed isolated-phase bus, similar to that in the new extension, will soon be installed. An additional section of bus between the new and old plant will see the light of day in the near future. There will be a tie-in between this latter section and the new section as indicated on the schematic diagram above.

Frequency Conversion. Although the system, both new and old, is fundamentally 25-cycle, all station auxiliary equipment in new extension will operate on 60-cycle. This is handled by first sending 11-kv power at 25 cycle through a 6000-kva transformer, reducing voltage to 4160. It is then fed into a frequency converter and taken out at 2400 v, 60 cycle. This 60-cycle feed is then tapped to both 2400-v station buses through individual circuit breakers.

Auxiliary equipment such as coal crushers, fans, pulverizers, etc, are fed from these buses. In addition, each bus is tapped through a circuit breaker to a tie with the local utility lines. To do this, step-up transformers are used in each feeder, raising the 2400 v up to 13.2 kv. Therefore, should a fault occur in the frequency converter both 2400-v buses can be kept alive through either or both ties from the local utility company. This feature simplifies maintenance problems on the frequency converter besides increasing reliability.

Relay Protection. The generator, 11-kv buses and frequency-changer transformer are all protected through overlapping differential-relay protection. Current transformers in each case are located on the far side of the protected unit giving the wanted overlapping zone of protection. On the most severe fault (1,450,000 kva calculated) the differential relays will clear the required breakers in not more than 2 cycles.

All 11-kv feeders have conventional overcurrent and ground relay protection. The two sets of tie feeders running to the 74th St Power Station (another generating plant feeding the New York City subway system) have power-balance relays in each set.

In addition to a complete metal enclosure on the bus and switchgear a fireproof non-bearing wall separates electrical galleries from the main machine bay.

Plant Load. Just about all generated power is taken by outlying synchronous converter substations fed through underground feeders. Since the synchronous converters are generally operated close to unity pf, there is no real pf problem reflected back to plant.

Most substations are manually operated. Many have been in continuous operation close to 50 years. Peak loading comes twice each weekday; coinciding with morning and eve rush hours.

(More on next page)

PRINCIPAL POWER-PLANT EQUIPMENT

59th Street Power Plant Extension, Board of Transportation, New York City

STEAM GENERATOR:

Boiler, 1 ..... Babcock & Wilcox Co
Radiant type, 600,000 lb per hr normal, 660,000 lb per hr max, 1300-psig 950-F steam, 6958-sq-ft furnace surface, 34,600-cu-ft furnace volume, 5358-sq-ft boiler surface. Two levels of combination coal and oil burners
Superheater, 1 ..... Babcock & Wilcox Co
2-stage pendant type, 30,570-sq-ft surface, spray type superheat control
Economizer, 1 ..... Babcock & Wilcox Co
Continuous tube, 17,800-sq-ft surface
Forced-draft fans, 2 ..... Sturtevant Div, Westinghouse Electric Corp
125,000 cfm at 100 F, 11.1 in. water, inlet vane control, 250 hp
Induced-draft fans, 2 ..... Sturtevant Div, Westinghouse Electric Corp
175,000 cfm at 295 F, 14.8 in. water, 600 hp
Induced-draft fan couplings, 2 ..... American Blower Corp
Hydraulic type, continuous pumping
Air heater, 1 ..... Babcock & Wilcox Co
Two section, tubular, 197,000-sq-ft surface
Pulverizers, 4 ..... Babcock & Wilcox Co
Ball-bearing, direct-drive, 17,500 lb per hr, table-type coal feeders, 100 hp, 600 rpm
Primary air fans, 4 ..... American Blower Corp
Direct drive, 14,000 cfm, 29.0 in. water, 100 hp, 1760 rpm
Soot blowers ..... Diamond Power Specialty Corp
Automatic sequential, pneumatically operated, retractable and stationary units

POWER GENERATION:

Turbine generator, 1 ..... General Electric Co
50,000 kw, 1250 psig, 950 F, 1 in. Hg abs, 1500 rpm, 39 stages, 5 bleed points, main generator 62,500 kva, 0.8 pf with 0.5-psig hydrogen pressure, 3 phase, 25 cycle, 11 kv, generator designed for future operation at 60 cycles
Surface condenser, 1 ..... Worthington Pump & Machinery Corp.
58,000 sq ft, 2-pass divided water box, spring supported, welded steel shell, storage-type deaerating hotwell, ⅞-in. aluminum-bronze tubes, 26-ft effective length
Circulating water pumps, 2 ..... Worthington Pump & Machinery Corp
Horizontal, bottom suction, 24,000 gpm, 34-ft total head, 295 rpm
Steam-jet air ejector ..... Worthington Pump & Machinery Corp
One triple element, three-stage with separate primary, secondary, and tertiary condensers, capacity at 1.0 in. Hg abs, 28 cfm free air
Condensate pumps, 2 ..... Foster Wheeler Corp
Horizontal, 3 section, 900 rpm, 1st section: 970 gpm, 116-ft net dynamic head; 2nd section: 970 gpm, 112-ft net dynamic head; 3rd section: 1052 gpm, 362-ft net dynamic head
Condensate recirculating pump, 1 ..... Dean Bros
Horizontal single stage, 320 gpm, 116-ft net dynamic head

FEEDWATER SYSTEM:

Boiler feed pumps, 3 ..... DeLaval Steam Turbine Co
Horizontal, 7 stage, barrel type, 835 gpm at 4210-ft total head, 3470 rpm
Hydraulic couplings, 3 ..... American Blower Corp
Sliding scoop, variable speed, 3575 rpm
Feedwater heaters, 2 ..... Foster Wheeler Corp
Jet type, counterflow, low pressure, non-storage
Feedwater heaters, 1 ..... Cochrane Corp
Vertical, counterflow, tray type, 8000-gal storage capacity
Feedwater heaters, 2 ..... Foster Wheeler Corp
Horizontal, closed, lock head, 2-pass, internal drain coolers, one heater with desuperheat zone
Evaporator, 1 ..... Westinghouse Electric Corp
Horizontal, single effect, 1620 sq ft, 25,000 lb per hr
Evaporator deaerator, 1 ..... Cochrane Corp

COAL HANDLING SYSTEM:

Conveying equipment ..... Robins Conveyors Div, Hewitt-Robins, Inc
275 tph, 4 conveyors, travelling tripper
Magnetic separator ..... Dings Magnetic Separator Co
Bunker, 1, 2500 ton ..... Harris Structural Steel Co
Coal gates ..... Stock Equipment Co
Automatic coal scales ..... Richardson Scale Co

DUST & ASH HANDLING SYSTEM:

Electrostatic precipitator, 1 ..... Koppers Co, Inc
Ash handling system ..... Allen-Sherman-Hoff Co
26 cu yd per hr, mechanical exhauster system, 185-cu-yd storage tank

PUMPS:

Salt-water service, 3 ..... Frederick Iron & Steel Co
Fire, 2 ..... Frederick Iron & Steel Co
Condensate transfer, 2 ..... Frederick Iron & Steel Co
Hotwell overflow, 1 ..... Worthington Pump & Machinery Corp
Evaporator feed, 2 ..... Frederick Iron & Steel Co
Cooling water service, 2 ..... Frederick Iron & Steel Co
Fuel oil, 2 ..... Sier Bath Gear Co
Lubricating oil transfer, 2 ..... Sier Bath Gear Co
Evaporator drip, 2 ..... Ingersoll-Rand Co
Lubricating oil agitator, 1 ..... DeLaval Separator Co
Lubricating oil return, 1 ..... Viking Pump Co
Chemical feed, 5 ..... Milton Roy Co
Weil Pump Co
Sump ..... Nash Engineering Co

AIR COMPRESSORS:

Soot blower, 2 ..... Chicago Pneumatic Tool Co
Combustion control, 2 ..... Pennsylvania Pump & Compressor Co
Station service ..... Chicago Pneumatic Tool Co

PIPING & VALVES:

Main steam piping
High-pressure boiler feed piping ..... Midwest Piping & Supply Co
High-pressure bleed steam piping
Intermediate and low-pressure piping ..... Asco Supply Co
Elliott Co
Strainers ..... Andale Co
Leslie Co
Rubber expansion joints ..... U.S. Rubber Co
Nickel cast iron pipe ..... Warren Foundry & Pipe Co
High-pressure steam traps ..... Yarnall-Waring Co
Low-pressure steam traps ..... Clark Manufacturing Co
Piping & duct insulation ..... Charles S Wood & Co
William Powell Co
Edwards Valves, Inc
High-pressure steel valves ..... Crane Co
Manning, Maxwell & Moore, Inc
High-pressure check valves ..... Chapman Valve Co
Steel gate and check valves ..... William Powell Co
Crane Co
Safety valves ..... Manning, Maxwell & Moore, Inc
Bleeder check valves ..... Attwood & Morrill Co
Fisher Governor Co
Regulating valves ..... Bailey Meter Co
Pressure relief valves ..... Manning, Maxwell & Moore, Inc
Iron valves ..... Darling Valve & Manufacturing Co
Circulating-water reverse flow valves ..... Henry Pratt Co
Valve operating equipment ..... Philadelphia Gear Works

MISCELLANEOUS:

Water and lubricating oil tanks ..... Eastern Steel Tank Corp
Air receivers ..... M W Kellogg Co
Zeolite water softeners ..... Cochrane Corp
Oil purifying equipment ..... DeLaval Separator Co
Air conditioning equipment ..... Trane Co
Dust separators ..... American Air Filter Co
Ventilating fans ..... Trane Co
Elevators ..... Watson Elevator Co
Fire protection equipment ..... Walter Kidde Co
Combustion control equipment
Plant instruments ..... Bailey Meter Co
Feedwater regulator

CONSULTING ENGINEERS ..... Burns and Roe, Inc

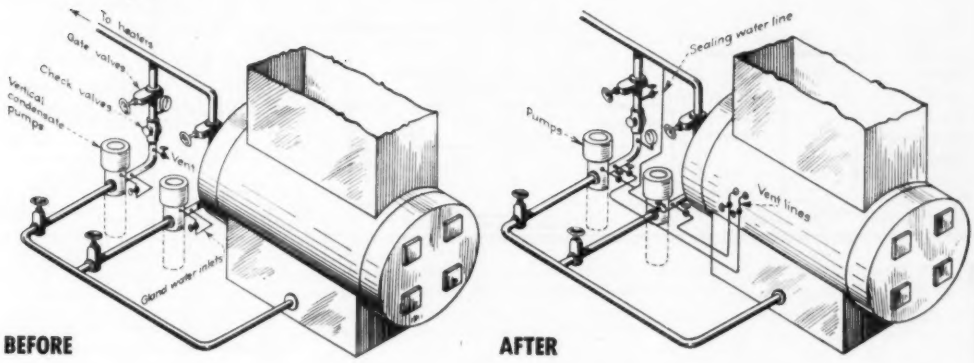
In the previous two pages we covered the highlights of both steam and electrical generation. It is also of interest to note the arrangement for handling air and water in the modern plant. For instance . . .

Fans. The vane-controlled, forced-draft fans when operated singly will handle enough air to let boiler supply 430,000 lb per hr. Each is powered by a 250-hp, 1200-rpm motor operating off the 3-phase, 2300-v, 60-cycle bus. The i-d fans can be operated individually matching the above performance. Each has a damper arrangement to cut-off the non-operating fan. And each i-d fan is powered by a 600-hp, 900-rpm motor tapped off the 2300-v bus. Hydraulic couplings are operated by remote control.

Closed Cooling-Water system for general plant service circulates water through the heat exchanger into the i-d and f-d fans, primary-air fan bearings, air compressor inter- and after-coolers, oil coolers, transformer cooling-water coils, etc.

Cooling water system will receive its initial supply from the condensate system. A connection has been made to city water service for emergency use. Normally the cooling water surge-tank level is maintained by the low-level transfer pumps. Leveling valve at surge-tank inlet, from low-level transfer pumps, regulates flow of condensate to hold fixed water level. High- and low-level switches are installed on surge tank to warn operators. One of the two cooling water circulating pumps will be in service at all times. Sight-flow devices help in regulating flow.

Rx Could You Cure This Headache?



Case No.4—THE PUMP THAT LOST ITS PRIME

. . . another story in the series on plant troubles by Don Swift, Ebasco Services Inc

► WATER USUALLY seeks its own level, but in this case it had to be persuaded. The installation was a new 30,000-kw condensing turbine-generator with a surface condenser having a large storage-type hotwell. A 10-in. suction line, about 25 ft long, carried the condensate to two vertical-type hotwell pumps. Normal water level in the hotwell was about 30 in. above the pump base plate. Pump inlets were about 3 ft below the base plates, being close to the bottom of the steel pump pits. Pumps were self-sealed at the top packing sleeve. Discharge water was piped as shown above for transmission to feedwater heaters, deaerator and boiler feed pumps.

Pump Sealing. With no vacuum on the condenser, water readily ran into the pump pits and filled the pumps, if the vent valves just below the check valves were opened. Priming the pump this way, no trouble was normally experienced with starting it. But if the condenser was run for some time, using one condensate pump, and it was decided to switch to the other unit, complications sometimes arose. Though arranged for self-sealing, the idle pump when not running was actually not sealed. The large suction valve was usually left open, with the idea of having water in the pump well and to facilitate putting the pump in service. Vacuum in the suction line pulled air in through the packing gland and the pump bowls acted like a U-tube so the unit eventually filled with air, even though the pump pit was full of water.

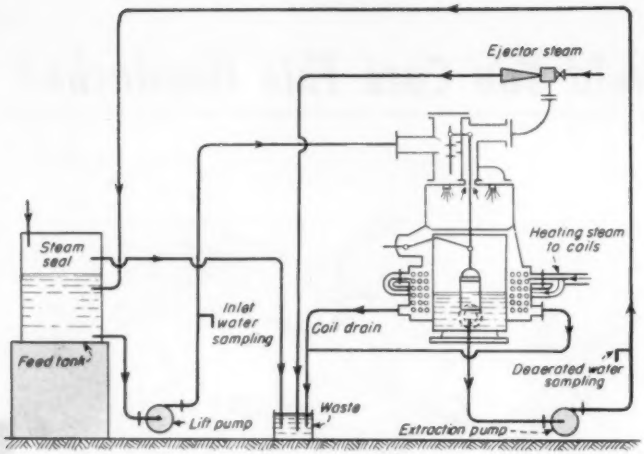
Trouble. One day the operator started the idle pump, saw pressure on the gage (improperly located above the check valve) and assumed the pump was doing all right. He then opened the discharge valve and shut down the other pump after closing its discharge valve. He noticed the pressure drop on the newly started pump's gage. But he assumed this was caused by the high hotwell level opening the level regulator and loading the pump too far out on its head-capacity curve. Actually the pump was not delivering water and the pressure was the deaerator pressure, plus static head of the water.

After a short time hotwell level rose enough to sound the alarm, and the operator realized the pump was not removing water from it. In addition, lack of condensate flow for cooling began to affect the steam-jet air pump and the condenser vacuum started to fall. To complicate matters, water in the deaerator dropped to a critical level, with boiler feedwater being pumped out and no condensate coming in.

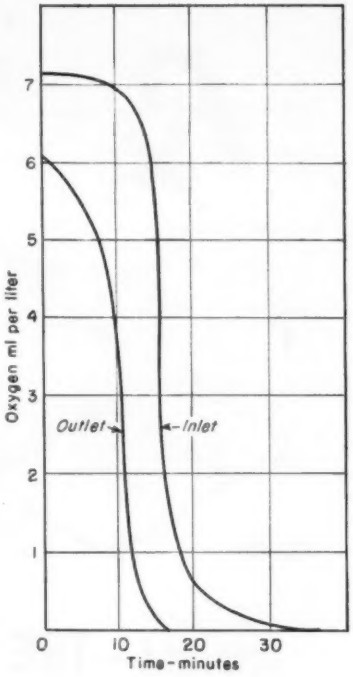
Hurrying to put the original pump back on the line, the operator opened the vent, allowing air to partly fill the bowls. Fortunately after several tries at running the pump, enough water was vented out to empty the pump of air, and pressure then built up rapidly. The pump came back into service barely in time to avoid shutting down the turbine because of loss of vacuum, or the boiler because of lack of feedwater.

Remedies. Several changes were made to prevent recurrence of this unhappy incident, as shown in the illustration at right. Locations of discharge gages and vents were interchanged so the gage always read only the pump pressure, this also made it impossible to vent air back into the pump.

The packing gland-water inlet was connected to a line taken from the discharge header so sealing water was always available no matter which pump was running. As a third precaution, vent lines were run separately from the pump outlet back to the condenser vacuum space. These vents and the suction valve are kept open on the idle pump. Thus the water can seek its own level and the pump is always primed full and ready to run. The vent line is shut off on the pump that is operating to prevent recirculating condensate.



1 Interfering factors creep in from impurities in the water, air leaks in sampling so a closed circuit for test runs was devised, *above*, to get pure water



2 Test results, *right*, of samples from closed circuit had to give zero oxygen readings by the Winkler method before the new method of estimating was tried

New Way to Estimate Dissolved Oxygen

Oxygen-free feedwater is vital to good boiler operation. Here is an accurate check on figuring traces of dissolved oxygen, using an organic solvent. It was developed by J Arnott, J McPheat and F B Ling* of G & J Weir, Ltd, Glasgow, Scotland

► PROPER DEAERATION in high-pressure high-temperature steam plants is a fundamental design consideration. Water and steam at the right degree of alkalinity and free of dissolved gas, especially oxygen, go a long way toward avoiding corrosion. Today power stations and many other large steam users call for a deaerated water with a residual oxygen content no more than 0.2 milliliter per liter (ml per l), and often as low as 0.005. When you consider a content of 0.02 ml per l is equivalent to one part in 34 million by weight, you can readily realize the need for an accurate test to estimate dissolved oxygen in deaerated water.

The Winkler method or some variation of it gives very good estimates for dissolved oxygen for low- and medium-pressure boilers. Yet with the Winkler method a zero result doesn't really mean a completely oxygen-free water. In fact, the water may contain up to 0.02 ml of oxygen per liter.

Chief objection to the Winkler method or its various modifications is that they all depend, finally, on titration to either an endpoint that involves observance of a delicate color change in a large volume of solution or to a final electrometric reading. Electrometric readings work well with high-purity water but not with all industrial waters. Because of this, one instrument, now on the market, records the dissolved oxygen content of the water and then sounds a warning of *increase* in oxygen content rather than give absolutely dependable figures.

Oxygen Content of Deaerated Water

a	b	c	d
0.0060	0.0023	0.0006	0.0008
0.0062	0.0020	0.0011	0.0012
0.0060	0.0017	0.0006	0.0011
0.0059	0.0014	0.0000	Spoiled

The answer to the chief objection—titration—would be, we felt, a method of solution concentration that would let us use a large sample to start out with. Such a sample would insure enough dissolved oxygen to make an estimate. Yet the method should wind up so final titration could be run on a small volume. Thus sensitive color changes would easily show.

Here is what we did (steps given on facing page): We began with a large bulk of sample and proceeded by the normal Winkler[1] method up to the point where iodine is liberated. Then

*Abstracted from the May 1950 issue of "Engineering," pp 553-555, 3-36 Bedford St, Strand, London WC 2.

[1]ASTM Standards on Industrial Water, ASTM, 1916 Race St, Philadelphia 3, Pa.
[2]ASTM, Proceedings, Vol 34, part II, p 796 (1934)
[3]ASTM, Proceedings, Vol 37, part II, p 615 (1937)

HOW TO ESTIMATE DISSOLVED OXYGEN USING AN ORGANIC SOLVENT

REAGENTS:

Manganous chloride (40 g of $MnCl^2 \cdot 4H^2O$ in 100 ml of water)
Alkaline iodide (70 g of KOH + 15 g of KI in 100 ml of water)
Sulfuric acid (Analar H_2SO_4 diluted 1 to 1 with water)
Starch (0.5% soluble starch made up in boiling water)
Sodium thiosulfate (N/200 freshly made up from diluted N/10 solution)
Iodine (N/200 freshly made up from diluted N/10 solution)
Carbon tetrachloride free from oxidizing or reducing impurities

APPARATUS:

Narrow-mouth sampling bottle—1100-ml capacity
Sampling tube—long enough to reach to the bottom of sampling bottle
Cooling coil in sampling line
Burettes
Separators; funnels; one, over 1000 ml; one, 200 ml
Flask pipettes

PROCEDURE:

1 Sample cooled to below 56 F (preferably less than surrounding air temperature). Rate of sample flow at least 1 liter per minute (preferably double this)
2 Withdraw sample-bottle stopper; put in sampling tube being careful to reach foot of the bottle; let water flow long enough to fill bottle 5 times; withdraw tube; replace stopper
3 Add one ml manganous chloride and one ml of alkaline iodide solution rapidly by pipettes with tips below water surface. Replace stopper. Mix reagents by rotating bottle. After one minute's time add 3 ml of sulfuric acid
4 Measure out exactly 1000 ml into a separating funnel of over 1000-ml capacity. Add 30 ml of pure carbon tetrachloride; shake mixture for one minute; then let it settle
5 Run off lower layer of carbon tetrachloride into a second separating funnel of about 200-ml capacity. Add 30 ml of carbon tetrachloride to remaining water in large funnel. Run off lower layer as before. (Four such extractions should be enough to give virtually complete iodide extraction with oxygen content below 0.05 ml per l. In case of doubt continue extracting until apparently colorless liquid shows; then draw off once more.)
6 Add 30 ml of water to combined carbon tetrachloride extracts and follow with accurately measured N/200 sodium thiosulfate just in excess of that required to read with iodine present. Shake and let settle. Carefully run off colorless carbon tetrachloride layer and discard
7 Transfer aqueous layer to a flask. Acidify with sulfuric acid. Titrate with N/200 iodine in presence of starch to determine excess sodium thiosulfate

RESULTS:

Amount oxygen in the sample, expressed in ml per l is the difference between volumes of N/200 sodium thiosulfate added and iodine used in back-titration multiplied by 0.028. (The N/200 solutions of thiosulfate and iodine should be so adjusted that they are exactly equivalent when 2 ml of thiosulfate is titrated with iodine under conditions above, *Procedure*).

---

we brought in an organic solvent to extract the iodine and separate it from the water. Iodine in the solvent itself was removed by water containing a slight excess of thiosulfate, which we titrated back with iodine.

What is this solvent? What part does it play? First off, we wanted a solvent that gave the maximum degree of extraction, that is, dissolved iodine to a much greater degree than water. Next, it should be denser than water and nonmiscible with it. Further, we wanted it to be nonflammable and readily available at a reasonable cost in a pure form. The best solvent we found was carbon tetrachloride.

Test Problems. We knew that the presence of potassium iodine in the water, 0.15 gr per liter, added in steps (Step 3, *Procedure*, top of page) increased the solubility of iodine and thereby reduced the effectiveness of the extraction by the solvent. Experiments showed us we could improve the efficiency of extraction by cutting down on the potassium iodide concentration (*Reagents*, top of page.)

But there were a number of other factors that had a bearing on extraction efficiency and so we felt it unwise to reduce the concentration. For instance, the vigor of shaking during extraction can't be standardized and so efficiency of this operation alone can vary. Moreover, the number of times carbon tetrachloride is added for a test can vary. Three extractions usually prove enough with 30-40 ml additions each time. The only guide to the number of additions is the rate the color diminishes in each successive extraction.

Color in the collected solvent layer (Step 5, *Procedures*, top of page) seemed so distinct that we tried to measure it with an absorptiometer. But even with a 4-cm glass cell and an appropriate color filter the drum difference readings were too small to be useful.

Removal of iodine from the solvent itself was easy. Just shaking with water containing a slight excess of thiosulfate did this job handily.

Interference Factors. One of the early objections to the Winkler method was the interfering effect of various factors. The Schwartz and Gurney[2] and then the Daugherty[3] modifications were meant to neutralize the effect of interfering factors by multiple sampling and adding reagents in reverse order. We decided to study the effect on our estimating test by running experiments using an oxygen-free water.

To get it, we set up a closed circuit, Fig. 1, where water circulates continuously from a steam-sealed tank through a pump into a small deaerator and back to the tank by way of an extraction pump. Water enters the deaerator at the top and passes through several spray nozzles into a central compartment. From here it passes to a side port and comes in contact with steam-heated tubes that raise its temperature to rapid boiling. The water then goes over to a port on the other side equipped with another set of steam-heated tubes, and to the outlet. An air ejector maintains a vacuum corresponding to the desired final water temperature.

Feed tank holds about ½ ton of water and the deaerator and piping probably another ½ ton. Samples come off the discharge side of the extraction pump and are passed through a large cooling coil. The only water losses in the system come from steam withdrawn by the air ejector, an intentional slight leakage at the pump glands and sampling. If a long run is planned, 2-hole rubber stoppers are fitted to the sampling bottles and water returned to the feed tank. That way a 3-hr run can be made without adding raw water.

Our closed circuit setup works like this. From a cold start the oxygen content of the extraction-pump discharge water falls from 6 to 7 ml per liter down to zero by the ordinary Winkler test in 25 minutes. In 10 minutes more, depending on rate of heat input, water in the feed tank shows zero oxygen. By this time feed-tank temperature runs about 205 F and deaerator outlet temperature 208-210 F. From here on, temperatures and pressures hold steady until the tank nearly runs dry.

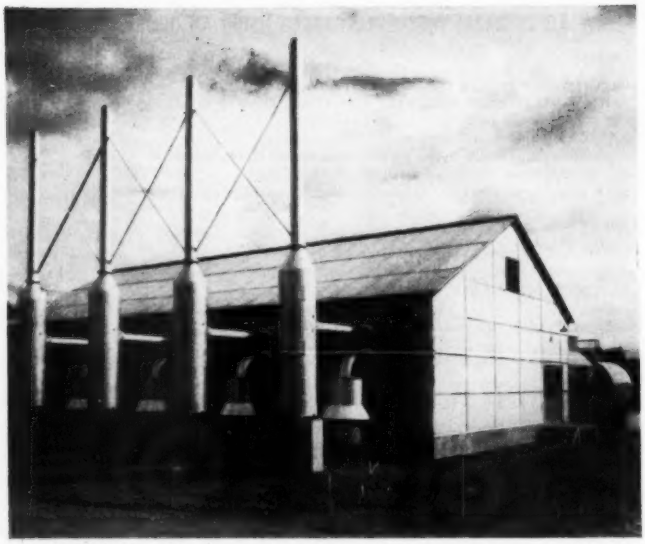
Fig. 2 shows test results of a typical run. Samples are taken every five min-

(*Continued on page* 204)

▶ **Northern States Power Co engineers decided to put part of new system capacity in smaller communities and at ends of radial transmission lines for reserve and peaking . . .**

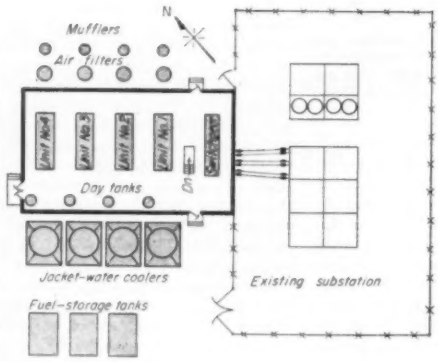
▶ **For this job, they developed diesel plants of standardized unit design, to cut delivery and construction times, keep costs to a minimum . . .**

▶ **They worked out cooling system suitable for these special conditions of operation, solved problems of noise and telephone interference, trained new personnel. And they found out . . .**



TYPICAL 4-UNIT PLANT has standardized steel-frame composition-covered building

How Standard-Design Diesel Plants on



TYPICAL STANDARDIZED PLANT LAYOUT

Generating units, auxiliaries and switchgear, with required synchronizing, metering and protection, are housed in steel-frame composition-covered buildings (photo above). One section, 18 x 43 ft, is common to each plant, for switchgear and general operation. Sections 14 x 43 ft are added for each generator unit. Mufflers, filters are outdoors on one side, jacket-water coolers on other. Fuel tanks are 10,000 gal each; one plant has 4, three have 3 and six plants have 2.

By **E F CARLSON and H E RHOADES,** *Northern States Power Co**

► BACK IN 1946, engineers of Northern States Power Co made a study of generating facilities needed for its rapidly expanding system. They found that part of additional capacity planned should be placed in some of the smaller communities and at the end of some of the radial transmission lines, for reserve and peaking purposes.

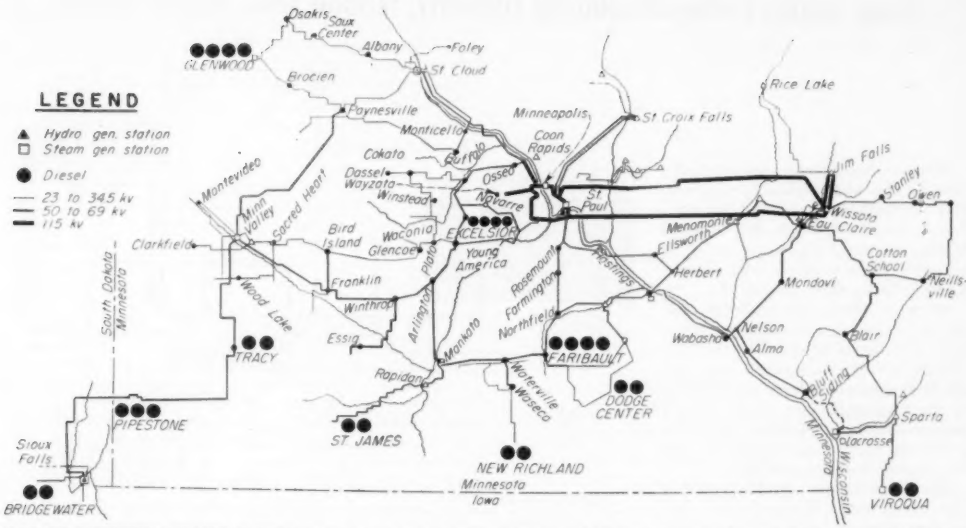
Install Diesels. This led to decision to install approximately 27,000 kw of diesel generating equipment. In plants designed on a standardized unit basis, units of approximately 1000 kw each were spotted in groups of two, three and four at strategic locations on the interconnected system where transmission and distribution facilities were available and would be relieved.

Quick Delivery. Although final commitments were not made until Feb 1947, 14 of the units were in service for the 1947 peak load and contributed substantially to rendering uncurtailed service to customers.

In all, 27 diesel units were installed in ten plants on the system extending across Minnesota and into Wisconsin and South Dakota (see map). Each installation was associated with an existing distribution substation. Generators, at either 2300 or 4160 v, connected to the distribution-feeder bus. This provided a direct supply for load in the area in case of line outage, relief for overloaded transmission lines and transformer banks and solution of voltage problems, as well as additional system capacity.

Installed Cost of these standard-design plants was ap-

*Based on a paper presented at the 1951 Midwest Power Conference. Mr. Carlson is results engineer, Mr. Rhoades is general superintendent of electrical plant section



MAP OF NORTHERN STATES SYSTEM shows how diesel plants were spotted in small communities, at ends of transmission lines

a Utility Power System Pay Dividends

proximately $160 per kw. Of the 27 units, 15 were General Motors and 12 American Locomotive (see typical plan, *left*, and table of major equipment, *right*).

Operating personnel were recruited from employees in each locality who signified a desire to become diesel operators. Since these plants were intended for intermittent duty, arrangements were made for keeping men at their regular jobs except when they were needed in the diesel plants. This scheme proved generally satisfactory.

Training Operators. Potential diesel operators came from practically every occupation in the company and in very few cases had had any previous work on diesel engines. Candidates were assigned to their respective stations before plants were ready to start. This gave them a chance to get acquainted with equipment and layout. A supervisor remained in each plant for about a week after all units were started to give further training. Very little trouble resulted from using men who had, to begin with, practically no background in diesel-plant operation.

Operating Results. Records of these diesel plants show that their total generation amounts to only a fraction of 1% of total system output. Moreover, capacity factor of diesel plant having greatest yearly generation is only 7.3%, and for the lowest generation is only 0.5%.

These figures might indicate that the diesel plants are of little value or of minor importance. They have, however, been used to great advantage during peak-load periods which, of course, occur only a relatively few hours per year. It has also been demonstrated that they can go on the line quickly in emergencies, restoring service with a minimum of outage, as well as complementing system capacity.

In addition, a number of the transmission lines serving these communities have been rebuilt, using the diesel plants to maintain service while the work was done. This permitted the job to be handled with a minimum of hazard to personnel as well as at minimum cost.

The addition of diesel plants in the manner outlined above was a new venture for Northern States Power Co, but first four years of operation have shown that they have performed all of the functions for which they were installed in a highly satisfactory fashion.

MAJOR EQUIPMENT IN DIESEL PLANTS

Engines, 15	Electromotive Div, General Motors Corp
	Type 567B, 1400-hp, 720-rpm, 16-cylinder, 8½x10-in., 2 cycle units with intake blowers, 64-v battery starting
Engines, 12	American Locomotive Co
	Type 8, 1300-hp, 720-rpm, 8-cylinder, 12½x13-in., 4 cycle, turbo-charged units, with air starting (250 psi)
Generators, 15	Elliott Co
	1000-kw, 0.8-pf, 2400/4160-v, 3-phase, 60-cycle, 720-rpm
Generators, 12	Electric Machinery Co
	920-kw, 0.8-pf, 2400/4160-v, 3-phase, 60-cycle, 720-rpm
Exciters, 15	Elliott Co
	10-kw, 125-v, 2140-rpm, gear-driven from camshaft
Exciters, 12	Electric Machinery Co
	10-kw, 125-v, 720-rpm, direct-driven from main shaft
Circuit breakers, all plants	I-T-E Circuit Breaker Co
	Type HV-100, metalclad, truck-mounted, 600-amp, 5000-v, 100-mva, 125-v ac closing, 24-v dc tripping
Heat exchangers, 27	Alco Products Div, American Loco Co
	Type W-4-12, air-cooled, 25 hp fan motor

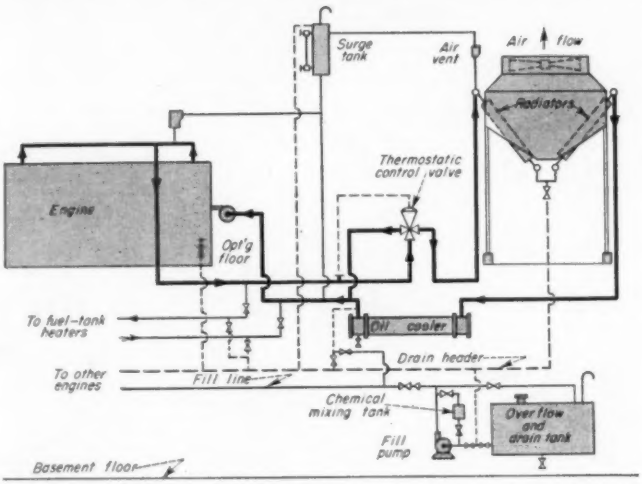
For further details, turn page

CLOSED COOLING SYSTEM DESIGNED FOR SIMPLICITY, FREEDOM FROM FREEZEUP HAZARD

Because these plants are primarily for standby and peakload operation, they are unattended much of the time. For operating simplicity and to avoid freezing hazard, air-cooled radiators using an ethylene-glycol type of antifreeze solution were selected.

In the resulting simple closed cooling system, engine-driven pumps circulate cooling solution from engine jackets through air-cooled heat exchangers mounted outside the building. A thermostatic bypass valve controls cooling-solution temperature. Oil cooler is between radiator and engine, so solution passes through cooler first.

Use of ethylene glycol presented some operating problems. Because this solution becomes acid with use, samples are sent periodically to the laboratory. These regular checks make it possible to anticipate any corrosive tendency. Polished-steel test specimens have been placed in the cooling system of each engine. These are removed at intervals and examined for any evidence of corrosion. Up to the present time, however, no troublesome corrosion has been encountered.



COOLING SYSTEM features use of air-cooled heat exchangers, ethylene-glycol solution and provision for draining and storage, to avoid freezeups, reduce corrosion

To preserve solution for longest possible time, it is removed from engines during summer months and placed in 2500-gal storage tanks in plant basements. Any sludge then has a chance to settle. When engines are refilled in the Fall, solution is pumped down only to within 6 in. of tank bottom. Solution below this point is drawn off; if free of sludge, it is reclaimed, otherwise wasted. In summer, cooling system carries softened water to which sodium chromate is added to inhibit corrosion. This treatment has so far proved successful.

SWITCHGEAR, GENERATOR PROTECTION AND CONTROL, TELEPHONE INTERFERENCE, NOISE

Switchgear for all plants is uniform. For each unit it consists of two metalclad cubicles, one for air circuit breaker and relays, other for field breaker, voltage regulator, instruments and controls. Each station has one metalclad cubicle housing surge-protection equipment and disconnecting fuses for station auxiliary transformers. All cubicles for generators and station auxiliary equipment bolt together to form a continuous metalclad structure. Potential transformers are in draw-out trays accessible from the rear. Hinged doors give access to current transformers and bus structure, which carries molded insulation.

Dry-type transformers (50 kva, 2400/4160 v to 110/220 v) furnish station auxiliary supply. There are no disconnects on generator breakers but trucks can be racked out into test position to clear contacts from bus and generator contacts.

Control, Protection. Each generator has overload relays with instantaneous and time overcurrent tripping features and targets. A reverse-power relay trips generator if engine loses power for any reason. On each generator a carbon-pile voltage regulator acts directly in series with exciter rheostat. No generator rheostats are provided. Regulators have cross-current compensation so one or more generators can be operated with their individual regulators in service if desired.

Generator control circuits require the field breaker to be closed before generator breaker can be closed. If generator breaker is tripped by relay, field breaker is also tripped. In addition, closing circuit of generator breaker is taken through synchronizing switch, so breaker cannot be closed unless synchronizing switch is in proper position. Synchronizing switch handle is removed at all times except when a machine is being put on the line. This prevents inadvertent closing of generator breaker.

To determine what shaft current would flow if outboard bearing were not insulated, a 4/0 wire was grounded and the bare end placed against the rotating shaft. A clamp-on ammeter reading showed shaft currents approximating 20 amp. According to the manufacturers, shaft currents under 40 amp can be tolerated.

Neutral Grounding. Only Glenwood and Excelsior plants were originally connected for grounded-neutral operation. They were scheduled to be equipped with a reactor in the common neutral to limit ground-fault current but these reactors were not available when plants went into service.

Both Glenwood and Excelsior are 4-unit plants (GM engines, Elliott generators) and at each the neutral current with one machine on the line at full load was about 165 amp. With four machines on at full load, current in common neutral approximated 500 amp. Oscillograph investigation indicated that this neutral current came principally from a third harmonic, which was not suppressed because the genera-

tors have a coil throw of 93.3% of pole pitch. There was a slight amount of neutral current due to slot harmonics and phase unbalance but these factors were minor in character and presented no problems.

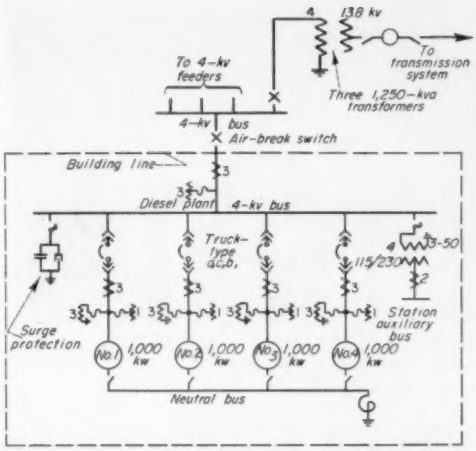
Telephone Interference. No telephone interference was reported as a result of the high third-harmonic currents in the Glenwood neutral. When Excelsior was started, particularly when the wye-delta 4160/13,800-v transformer bank in the substation was disconnected and the plant was feeding directly into the Excelsior 4-kv system, telephone interference was very severe. The 4-kv distribution system parallels a number of the Bell System toll lines.

An attempt was made to operate ungrounded at Excelsior, but this was impossible because synchronizing potential-transformer neutrals were not stabilized when machines were off the line. It was thus necessary to reground the generator neutrals with the understanding that the Excelsior plant would not be run with the 4160/13,800-v bank out of service until the neutral reactor was installed.

Reactor Installed. After reactor went in, tests indicated 55-amp neutral current with one generator at full load, and 85 amp with four generators at full load. These represented reductions of 67% and 83% respectively. Interference tests made over a period of several days after reactor installation indicated to the telephone company that operation of the plant would not be detrimental to the phone system, even with 4160/13,800-v bank out of service. Reactor, of course, presented three times the impedance to the third harmonic that it did to the fundamental frequency.

Noise Problems. Because of plant locations, complaints as to noise of operation were not received in most cases. One plant, however, was close to a residential district and some noise complaints came in, particularly in summer when windows were open. Noise measurements in the building near one engine indicated a sound level of about 108 decibels. At a point approximately 110 ft beyond the exhaust mufflers outside, the db reading was 77.

Noise-absorbing hoods were then installed over all four engines. Readings taken after this showed noise level inside building reduced to about 98 db, but noise at the point outside was at about the same level as before. It appeared that most of the outside noise came from the engine intakes even though they had filter-silencers. Additional silencers were then fitted to intake pipes close to engines. This proved effective in reducing noise level outside the building. Practically no complaints have been received since.



ONE-LINE DIAGRAM for 4-unit plant shows how engine-generator units tie to the distribution bus in existing substation

Gas Engines Vie With Steam in New Aluminum Plants

► EXPANSION PLANS announced by aluminum's "big three"—Alcoa, Reynolds and Kaiser—call for several hundred thousand kw of new power capacity. Reynolds and Kaiser will use natural gas as fuel, burn it in gas engines. Alcoa, pioneer in use of gas-engine power, takes a new tack—steam power using plentiful and cheap Texas lignite as fuel. Here's a brief roundup of the plans as they look now:

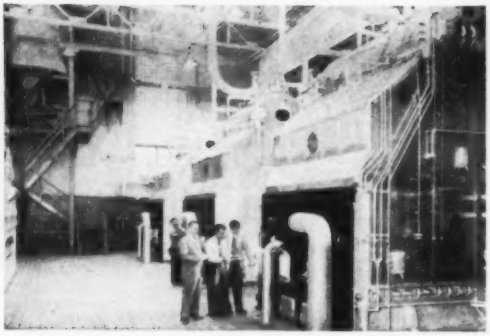
Reynolds Metals new plant is being built near Corpus Christi, Texas. They have ordered 40 Cooper-Bessemer supercharged gas engines (POWER, Feb 1951, pp 110-113) rated at 3700 hp each. When completed, with 256,000 hp for aluminum reduction and general needs, this is expected to be largest electric-generating project powered by internal-combustion engines.

Engines, of 16-cylinder V-type, are supercharged, new in spark-ignition gas-engine practice. At 327 rpm and 135 psi bmep, each engine will drive a 2500-kw generator. Of the 40 generating units, 31 will be dc machines for electrolytic reduction, while nine will supply ac for general plant needs.

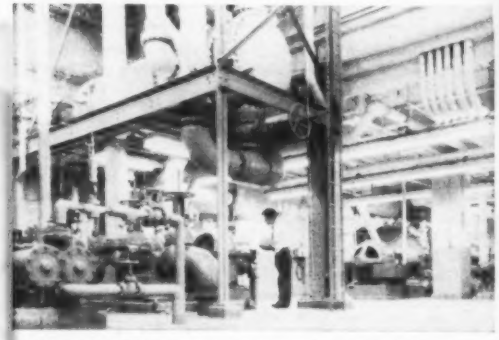
Kaiser Aluminum plant is under way at Chalmette, La. First of 80 Nordberg radial gas engines has been shipped. Generally similar to 120 units installed at Alcoa's Point Comfort plant, (POWER, July 1950, pp 76-81) these engines will drive 1290-kw dc generators. Of 2-cycle type, engines have 11 radial cylinders, 14x16 in. At 400 rpm they develop 1820 hp each.

Aluminum Co of America will locate its 85,000-ton-per-yr works about 60 miles south of Waco, Texas. Production is expected to start in Fall of 1952. Power-generating facilities will be built and operated for Alcoa by Texas Power and Light Co. Although detailed negotiations have not been completed, arrangement will provide for interchange of power between Alcoa-owned power plant and Texas P & L system. One advantage will be ability of Texas P&L to supply interim power for partial smelter operation before new generating plant is completed.

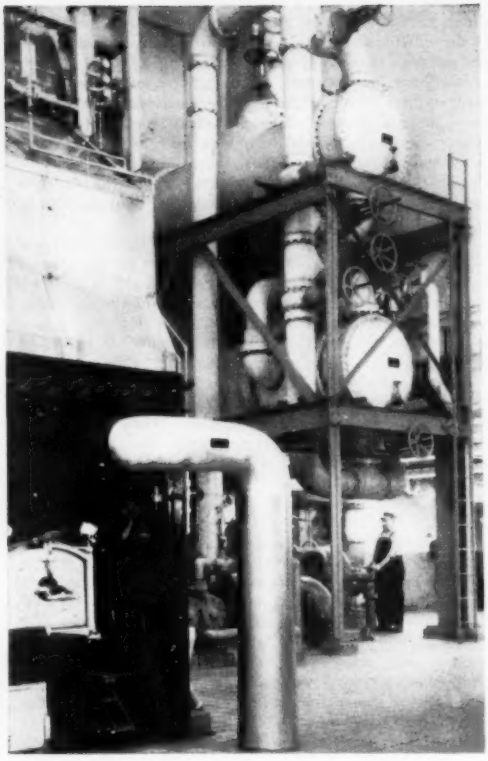
Major feature of this steam plant will be use of lignite, large deposits of which exist in Milam county area. Lignite's great promise as a major source of low-cost power was made possible by research sponsored by Texas P&L and the Bureau of Mines program in its pilot plant at Denver, Colo. Engineering surveys show lignite deposits existing to a depth of several hundred ft on the site of a prehistoric river bed. It can be extracted by both strip and slope mining and transported directly to the power plant. Eliminating cost of long hauls makes this fuel economical.



LIBERAL SPACE allowances in boiler room make excellent demonstration area for the advantages of high-bay lighting



TURBINE-DRIVEN feed pumps help in improving heat balance for power plant that supplies mostly building-heating needs



BECAUSE OF the nature of the steam load relatively little makeup water (8-9%) goes into this deaerating-water heater

How to Make Your Plant a Show Place

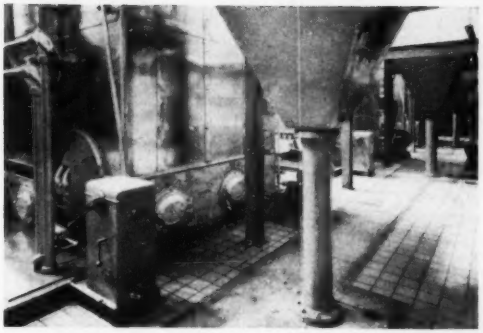
To see what can be done with good layout, functional design, well-chosen color schemes and modern lighting, take a walk with us through General Electric's revamped Nela Park plant

► WHEN THE TIME CAME for General Electric Co to modernize its power plant at the "University of Light," Nela Park, Cleveland, they decided to use the boiler room as a practical demonstration area for various lighting methods.

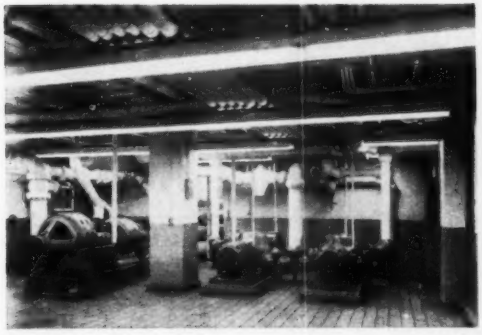
First off, they provided liberal space for the required three 160-psi 18,000-lb-per-hr spreader-stoker-fired steam generators. These they had enclosed in aluminum jackets, set on lined cinnamon floor tiles (see the cover photo). The ceiling is painted a yellow-tinted off-white; the upper walls are sunlight yellow; the lower walls blue-green.

Lighting is, of course, excellent. Illumination at the floor level averages about 35 foot-candles throughout. Fixtures vary considerably, some using 1000-watt filament lamps, others 400- and 3000-watt mercury types, and still others employing slim-line fluorescent lamps. The boiler room lends itself well to the demonstration of high-bay lighting techniques, in particular, with units mounted about 30 ft above the floor. There are also many examples of low-bay lighting.

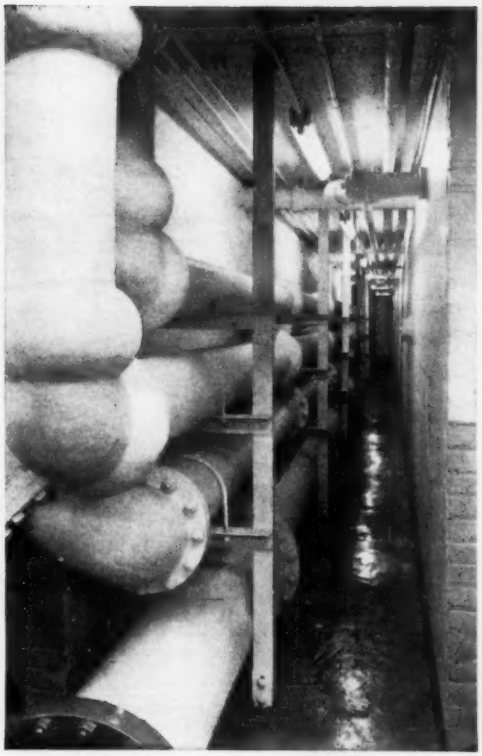
Coal Handling. An outstanding feature of the plant is absence of coal bunkers and coal- and ash-handling equipment, as such. Incoming coal goes to a coal bin under the boiler-room floor. At this point the pneumatic spreader stokers take over. Coal is metered as it leaves the bin by way of a metering worm driven by a variable speed transmission.. It is then dried, preheated and moves under pneumatic pressure to the distribution nozzles that spread coal over the furnace grate. A cinder reinjection system returns collected solids from the first boiler-pass hopper to the furnace for refiring to in-



HIGH AMONG boiler-room features is the dirt-free coal- and ash-handling equipment. The pneumatic system, removes ashes



PUMPS, *right,* deliver domestic hot water to sixteen buildings making up the plant; others are part of firefighting system



SERVICE TUNNEL connects plant buildings with powerhouse. Pipes carry steam for heating, domestic hot water, condensate

PRINCIPAL POWER-PLANT EQUIPMENT

Nela Park, Cleveland, Power Plant of General Electric Co

STEAM-GENERATING EQUIPMENT:

Boilers, 3	Babcock & Wilcox Co
18,000 lb per hr, 160 psi, saturated, stoker-fired	
Boiler, 1, 35 hp, hot water	Bryan Steam Corp
Stokers, 3	Iron Fireman Mfg Co
Spreader, pneumatic (200% boiler capacity)	
Regulators, damper	Bailey Meter Co
Flyash reinjection	Iron Fireman Mfg Co
Soot blowers, steam	Diamond Power Specialty Corp
Fans, forced, 2 per boiler	Iron Fireman Mfg Co
Fans, induced, 1 per boiler	American Blower Corp
Dust collectors, mechanical	American Blower Corp
Ash disposal	United Conveyor Corp

PUMPS & COMPRESSORS:

Pumps, boiler feed, 2	Worthington Pump & Mach Co Union Steam Pump Co
Turbine pump drives	General Electric Co
Pumps, 2, hot water, heating	DeLaval Steam Turbine Co
Pumps, 2, hot water, domestic	Gould Pumps, Inc
Compressor, 1	Ingersoll-Rand
Two-stage, motor-driven, 35 cfm, 100 psi	
Governors, pump	Fisher Governor
Pumps, domestic booster, 3	Gould Pumps, Inc
Pump, domestic, 1, variable-speed	Worthington Mfg Co
Pumps, fire system, 2	DeLaval Steam Turbine Co
Pump drives, fire system	General Electric Co
Pump, fire system, 1, diesel drives	Peerless Pump Div
Diesel drives	General Motors Corp

WATER TREATMENT AND STORAGE:

Chemical feeders	Milton Roy Co
Water-treatment system	W H & L D Betz Co
Feedwater heater, deaerating, 1	Sims Co
Storage, hot water, 2000-gal	Briggs Boiler Works

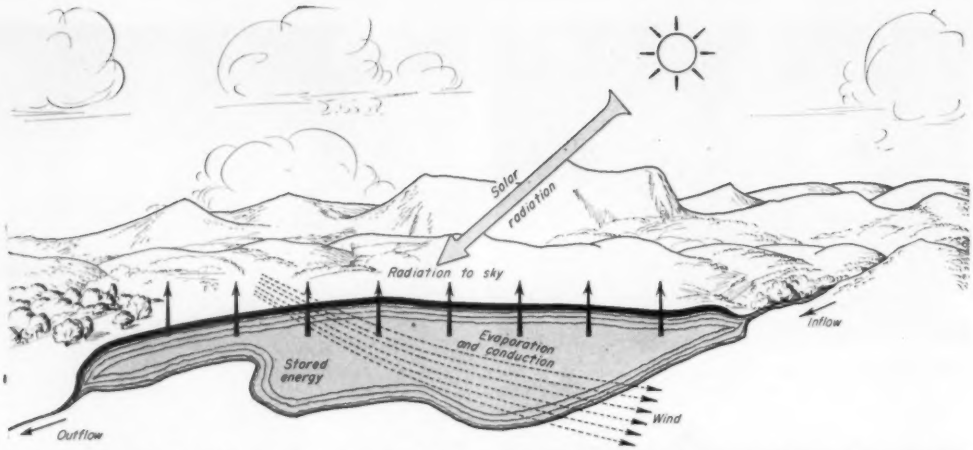
METERS AND INSTRUMENTS:

Flowmeters Feedwater temperature Smoke indicators Combustion controls Draft gages	Bailey Meter Co
Gage, pressure	Ashcroft (Manning, Maxwell & Moore Inc)

crease over-all boiler operating efficiency.

Flyash, collected from the boiler breeching and the dust-collector hopper, leaves the boiler cycle under the pull of a pneumatic ash-removal system. This same system removes the heavier ash dropped into hoppers under the furnace grate, and leaves the boiler cycle.

Net result of the use of underground coal storage, coupled with pneumatic coal and ash handling and flyash collection, is a neat, economical and clean-operating boiler room that fits in well with the show-place atmosphere General Electric engineers wanted to create.



1 Lake under natural conditions has continuously changing energy balance. Most times radiation from sun and energy from water inflow distribute to radiation to sky, warming of air, evaporation, warming of lake, and energy in water outflow

How to Predict Lake Cooling Action

Power plants in water-short areas often depend on lakes for condensing-water supply. Results of 25-year study show how lakes behave under varying heat loads, winds, air temperatures

By **R F THRONE**, *Supt, Steam Production Dept, Public Service Co of Colorado*

► STEAM POWER PLANTS using a condensing cycle need large amounts of condenser cooling water. As we know, this water must be at lowest temperature possible to obtain largest conversion of steam energy into electrical energy.

There are many inhabited areas not blessed with large quantities of water, especially a continuous supply. In such places available water must be used over and over again by recirculation. Heat picked up by the cooling water in the condenser dissipates to the atmosphere through a spray pond, or a cooling tower, or from the surface of a lake, either artificial or natural.

Expected performance of spray ponds and cooling towers can be predicted within a few degrees of actual results. Not so much has been known to date on the cooling performance of a lake surface. Earlier work reported by D O Lima, "Pond Cooling by Surface Evaporation," POWER, March 1936, pp 142-4, was the first correlation of lake-cooling performance to actual results.

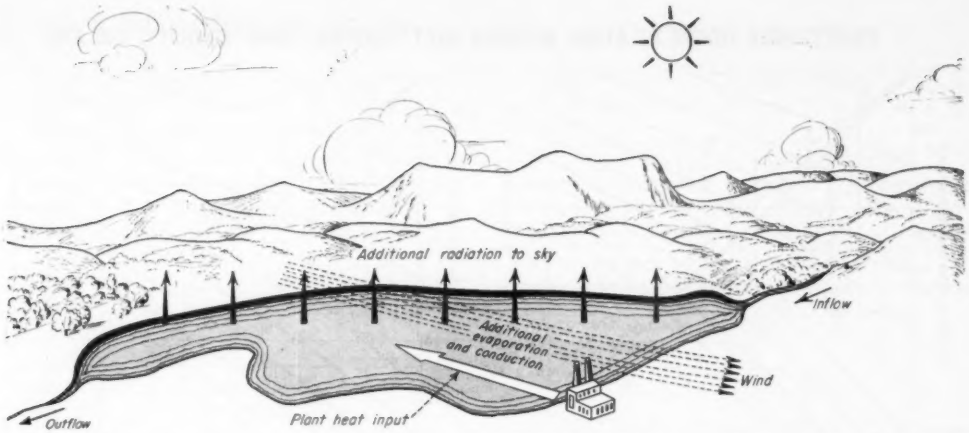
Practical examples. Beginning with initial operation of the Valmont Plant of Public Service Co of Colorado in 1925, regularly scheduled observations were recorded of the water temperature at various points on each of the two associated lakes. Readings were taken at the lake surfaces and at various depths, together with continuous recording of air temperatures and wind velocities.

This plant, of initial 20,000-kw capacity, first used one lake with 120 acres of surface. This lake also stores flood waters for irrigation uses. The plant is located so the lake can be expanded in stages to an ultimate area of about 530 acres. Up to now the plant has increased to 125,000-kw capability while the lake area grew to 210 acres. Lake was enlarged by conveying condenser discharge water to the second lake, which then operated in series with the original lake by a short connecting channel.

Adding turbine-generator units in the interval raised the heat-release loading on the first lake to an average monthly value of 140 Btu per sq ft per hr by 1943. This is for a monthly average station load of 630 kw per acre. At this time the second lake was cut in, reducing the heat release per sq ft by about 50%, and lowered the inlet circulating-water temperature (injection temperature) by about 10 F. Further increase in plant loading has raised heat release to 117 Btu per sq ft per hr on the enlarged lake area at improved station economy. Monthly average station load now runs at 530 kw per acre.

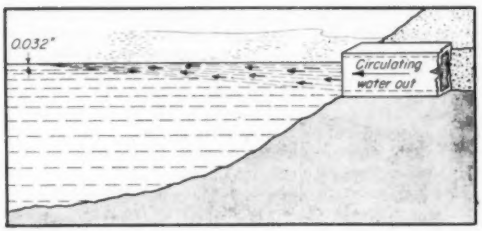
These lakes performed only partly in accordance with the laws established by earlier investigations. We made this further study to get better agreement between theory and actuality. We adopted the same method of attack as the earlier work by basing all data on monthly averages and referring to natural water equilibrium temperatures. In this case the latter was the surface temperature of the second lake before cutting it into the cooling circuit.

When "industrializing" a "natural lake" the pumps recirculate the water, causing two important changes: (1)

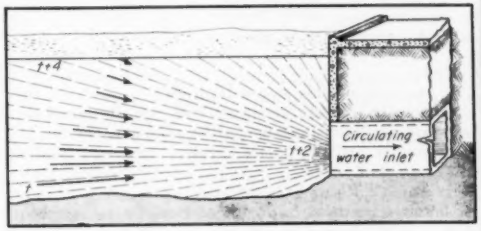


2 Plant cooling-water energy has its own balance imposed on top of lake natural-energy balance. Energy leaves as additional radiation to sky, evaporation of lake water, warming of air and wind, warming of lake, energy in lake outflow

HERE'S HOW CIRCULATING WATER FLOW BEHAVES AT PLANT INTAKE AND DISCHARGE



3 Cooling water leaving plant discharge quickly spreads out in thin layer at lake surface, temperature drops rapidly



4 Cooling-water intake draws water from all levels of lake depth, temperature averages that of all adjacent strata

Temperatures throughout the lake body increase. (2) Temperature stratification from surface to lake bottom reduces greatly but remains stratified throughout the year.

Heat Balance of Any Lake. In the Oct. 1927 issue of the *Physical Review*, Cummings and Richardson gave the heat balance of a natural lake in the form:

$$I = B+E+K+S+C$$

where all terms are in Btu per sq ft per hr, and

I = incoming solar radiation
B = radiation of lake surface to sky
E = enthalpy absorbed by evaporated water
K = energy conducted to wind and surroundings
S = energy stored in lake water by temperature rise
C = energy received or lost by water inflow, discharge, etc

Fig. 1 shows a pictorial version of this heat or energy balance. Energy coming in equals energy leaving except for energy stored by temperature rise of the lake water.

Heat Balance of Industrial Lake. Heat balance of an industrialized lake superimposes on the heat balance of the natural lake. The energy input from the plant must be dissipated as increments on top of the natural-energy outlets. Using subscript 1 for the lake in industrialized condition, and subscript 2 for the lake in its natural condition, we can show that the plant heat input works out as the following balance:

$$H = Q-C_1 = (B_1-B_2) + (E_1-E_2) + (K_1-K_2) \quad (2)$$

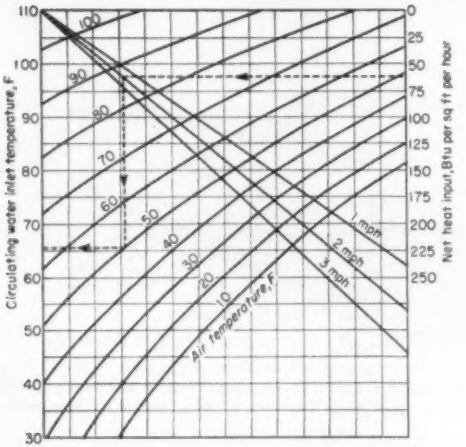
where all units are in Btu per sq ft per hr, and

H = net heat added to industrial lake
Q = gross heat from plant added to industrial lake
C_1 = inflow correction of industrial lake
B_1 = radiation from industrial lake
B_2 = radiation from natural lake
E_1 = enthalpy absorbed by evaporated water, industrial lake
E_2 = enthalpy absorbed by evaporated water, natural lake
K_1 = energy conducted to wind, etc, industrial lake
K_2 = energy conducted to wind, etc, natural lake

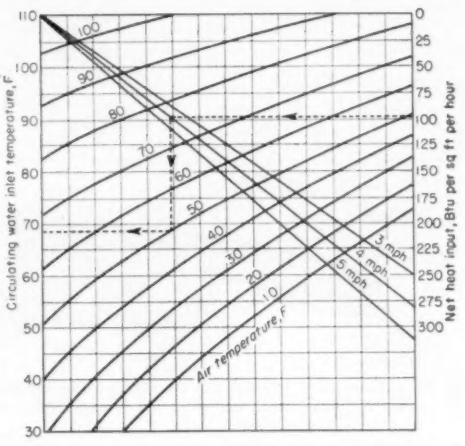
Fig. 2 shows this energy balance pictorially. I, as incoming solar radiation, and S, the warming factor (directly dependent on solar radiation), drop out of this balance since they are equal in both cases.

Gross Heat Input. All the factors are calculated from monthly averages. Gross heat input from plant is:

CHARTS HELP FIGURE RELATION BETWEEN HEAT LOADING, WIND VELOCITY, AIR AND . . .



5 Chart for figuring heat loadings and temperatures with wind speeds of 1 to 3 mph. Charts for 5000-ft elevation



6 Chart for figuring heat loadings and temperatures with wind speeds of 3 to 5 mph. Figures are monthly averages

$$Q = \frac{L \times R \ (e_b - e_t)}{43{,}560A} \qquad (3)$$

where
L = average monthly station load, kw
R = average monthly station net heat rate, Btu per kwhr
e_b = average monthly station boiler efficiency, %/100
e_t = average monthly plant thermal efficiency, %/100
A = lake area, acres
There are 43,560 sq ft in one acre.

Inflow Correction. C_i, is figured from the average hourly inflow water for the month and the difference of inflow-water and injection temperatures. Heat absorbed is ratioed over the sq-ft area of the lake. Inflow correction may be a major item; at times it was 25% of the gross Btu input in our study.

Radiation. Cummings and Richardson showed that $B = 1.04\ t$, where t is the water-surface temperature. Then it follows $B_1 - B_2 = 1.04\ (t_1 - t_2)$ where the temperatures are for surfaces of both industrial and natural lakes respectively.

Evaporation. Rohwer, Fort Collins, Colo., reported in *Technical Bulletin No.* 271, the evaporative rate for reservoirs, which we transformed to heat units as follows:

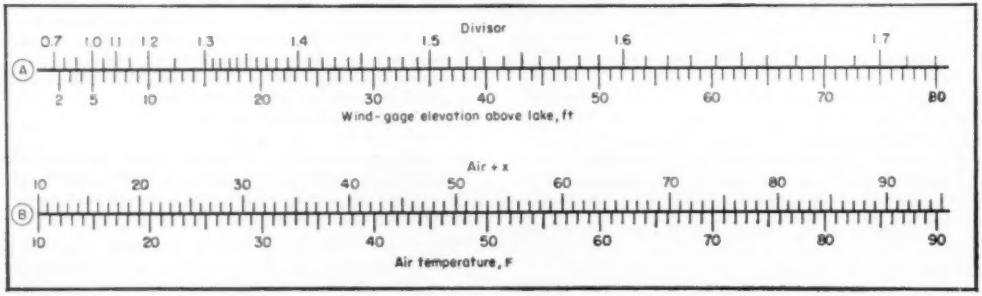
$$E = 78(1.0 + 0.268V)\ (e_w - e_4) \qquad (4)$$

where
V = air movement over lake, miles per hr
e_w = vapor pressure of water surface, in. Hg abs
e_4 = vapor pressure of air, in. Hg abs
Then for our energy-balance equation we can write

$$E_1 - E_2 = 78\ (1.0 + 0.268V)\ (e_1 - e_2) \qquad (5)$$

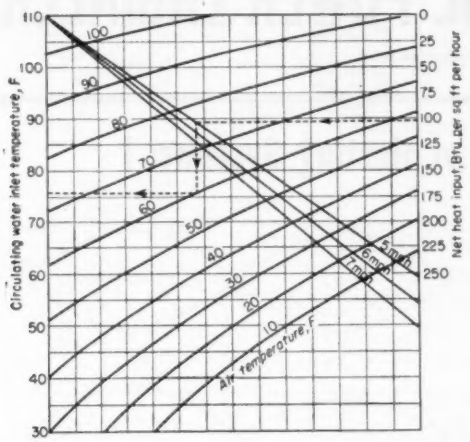
where e_1 and e_2 are the vapor pressures at the surface of an industrial and natural lake, respectively, in. Hg abs. The vapor pressure of the air cancels out, so there's no need to consider humidity.

Conduction. Investigators have shown that conduction varies directly with evaporation by a known variable ratio, that is $K = RE$. R known as Bowen's Ratio (see Bowen, *Physical Review*, Vol 27) has been adopted by many. Then



8 *A:* For wind gage elevations other than 5 ft above lake surface, divide speed by corresponding number on scale. *B:* Air temperature and corresponding lake-surface temperature (air + X) are based on average monthly values for given lake

. . . WATER TEMPERATURES FOR ANY LAKE



7 Chart for figuring heat loadings and temperatures with wind speeds of 5 to 7 mph. See text for measuring points

$K_1-K_2 = R_1E_1-R_2E_2$ where the subscripts apply to industrial and natural lakes, respectively. Converting Bowen's Ratio to English units, we get for a 25-in.-Hg barometer:

$$K_1-K_2 = 0.655\ (1.0+0.268V)\ (t_1-t_2) \qquad (6)$$

General Formula. Substituting all these values in (2) and simplifying, we have for 25-in.-Hg barometer:

$$H = 104\ (t_1-t_2)+78\ (1.0+0.268V)\ [e_1-e_2+0.0084\ (t_1-t_2)\ ] \qquad (7)$$

To apply this formula we must know the average surface-water temperature of the industrialized lake, t_1, and also what its temperature would have been before industrialization, t_2.

Industrialized Surface Temperature. Analysis of data we collected for 25 years shows that the water-surface temperature of the industrialized lake is an average of about 2 F above the actual injection-water temperature.

It's natural to assume the lake surface temperature approaches that of condenser discharge. But many actual temperature surveys show the discharge temperature quickly disappears after the water enters the lake. Little difference in temperature exists over the surface area of the lake. The warmer water lies in the top strata of the lake, which are very thin. Even though the bulb only of the thermometer is immersed, we found the surface temperature much below discharge temperature. The average discharge-water film is about 0.032 in. thick, Fig. 3, when operating at a load of 600 kw per acre with cooling-water circulation of 1.5 gpm per kw.

It's often assumed that when the condenser-pump suction is near the bottom of the lake, the coldest water in the lake strata is being pumped. Actually, the injection-water temperature is the average of that at the lake surface and bottom. The hydraulic gradient draws on all levels or strata in decreasing ratio upwards to and including the surface water, Fig. 4. Average water temperature then becomes the injection water temperature. Since the vertical range is about 4 F, the surface temperature for the industrial lake, t_1, is then fixed as $inj.+2$.

Natural lake surface temperature depends on the equilibrium of many variable factors, radiation (incoming solar and back radiation), evaporation and conduction, which in turn are affected by wind velocity and humidity. Water is a poor heat conductor, so higher temperatures are found on the surface. This is aided by the lower density of warmer water. Radiation, however, penetrates to depths of 25 ft, more or less.

In work reported by Lima, surface temperatures of water in pans vary from 3 F above to 3 F below air temperature. These depend on dimensions of the water pan, height above ground surface, depth of water, reflective value of pan sides, etc.

Data on our second lake while in its natural state established the relationship shown by Fig. 8*B*. For given air temperature, the corresponding surface temperature is given as $Air+X$.

Final Formula. Substituting the above values for the surface water temperatures, we have:

$$H = 1.04\ (t_{inj+2}-t_{air+x})+78(1.0+0.268V)\ [e_{inj+2}-e_{air+x}+0.0084(t_{inj+2}-t_{air+x})\ ]$$

All values are monthly averages. These cover a time period during which at least twice the volume of the lake is circulated through the condenser.

Care must be taken in measuring air temperature and wind velocity. These measurements must represent actual air conditions at the lake surface and not be influenced by nearness of the plant. The final formula is based on wind velocity 5 ft above lake surface. If the wind gage height is some other height, use the divisors found in Fig. 8*A*.

Fig. 5, 6 and 7 give the final formula in graphical form. Each of the graphs is for the middle value of wind velocity shown. Interpolating for 1 mph deviation introduces an error of less than 1 F.

Results. The formula has been applied to lakes in Oklahoma and Texas with results comparable to those we obtained in Colorado. Of the 298 months in our Colorado 25-year study, 98.6% of the months fell within ±5 F of actual temperatures, and 87.8% fell within ±3 F.

Heat Dissipation. The following tables show the distribution of heat dissipation between radiation, evaporation and conduction for various wind velocities, heat inputs, air and water temperatures.

Heat input = 50 Btu per sq ft per hr

Air	1 mph wind velocity				8 mph wind velocity			
temp	Inj	Rad	Evap	Cond	Inj	Rad	Evap	Cond
F	F	%	%	%	F	%	%	%
30	48.5	35.8	35.6	28.6	39.0	18.1	41.4	40.5
60	73.0	24.0	57.0	19.0	67.0	11.9	64.5	23.6
90	99.0	14.1	74.9	11.0	95.5	6.7	79.6	13.7

Heat input = 150 Btu per sq ft per hr

Air	1 mph wind velocity				8 mph wind velocity			
temp	Inj	Rad	Evap	Cond	Inj	Rad	Evap	Cond
F	F	%	%	%	F	%	%	%
30	74.5	29.6	47.0	23.4	55.5	17.3	47.3	35.4
60	90.5	20.3	63.5	16.2	77.0	11.0	67.5	21.5
90	110.0	12.4	77.9	9.7	101.5	5.9	81.9	12.2

Water Evaporated. Makeup water to replace evaporated water equals the heat so dissipated, divided by the latent heat corresponding to the water surface temperature. Assuming a 720-hr month:

$$\text{Inches of forced evaporation per month} = \frac{720E}{5670-2.95t} \qquad (5)$$

where E = Btu per sq ft per hr average for month from
t = injection water temperature plus 2F

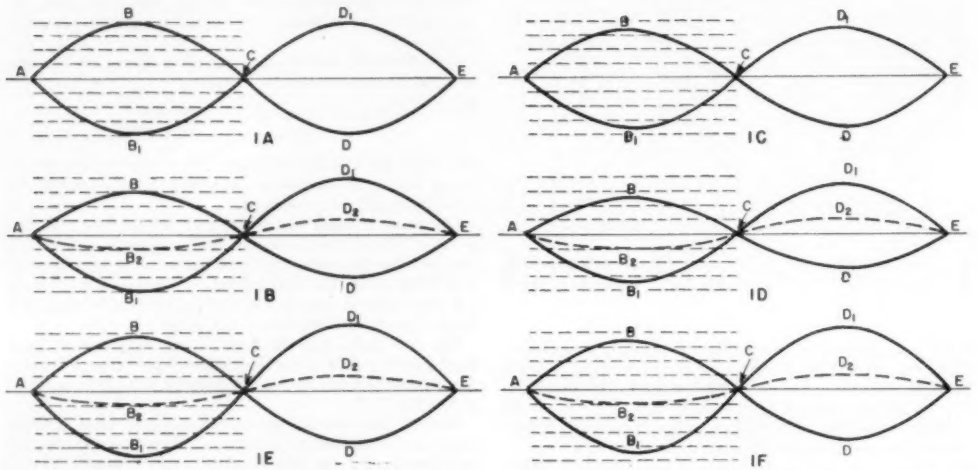
Makeup water to replace natural evaporation from (4) can be found when monthly wet-bulb air temperature is known.

(*Continued on page* 210)

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

41—Electronic Control of Heating Systems: I



1 Changes in bridge voltage on grid of tube T_1, Fig. 2 and 3. *1A*—Balancing the bridge voltages turns on the heat. *1B*—Bridge voltages unbalanced turn off the heat. *1C*—The bridge voltages balanced after a change in outside temperature turn on the heat. *1D*—Bridge voltages unbalanced after a change in outside temperature turn off heat. *1E*—Bridge voltages unbalanced by cycler to shut off heat. *1F*—Bridge voltage unbalanced from cycler, outdoor-temperature changes

► As SPACE-HEATING REQUIREMENTS become more exacting, so does the need for better room-temperature regulation. The old on-and-off thermostat control does not give the degree of comfort desired. When the thermostat turns off the heat, the heating system overshoots and there is overheating. Before the thermostat again turns on the heat, the room has cooled to where the tenants feel a chill.

For comfort, room temperature must not only be held constant when outside temperature is constant, but must change if outside temperature changes. When outside temperature decreases, room temperature should rise slightly to compensate for the colder walls.

Electronic Control. Building-heating demands led to development of automatic electronic heating-system controls. These are suitable for single-zone control of heating systems using gravity warm air, forced warm air, gravity hot-water, forced hot water, one- or two-pipe steam and radiant panels. Heat may be supplied from a central steam system or from a gas, oil, or stoker-fired heating plant.

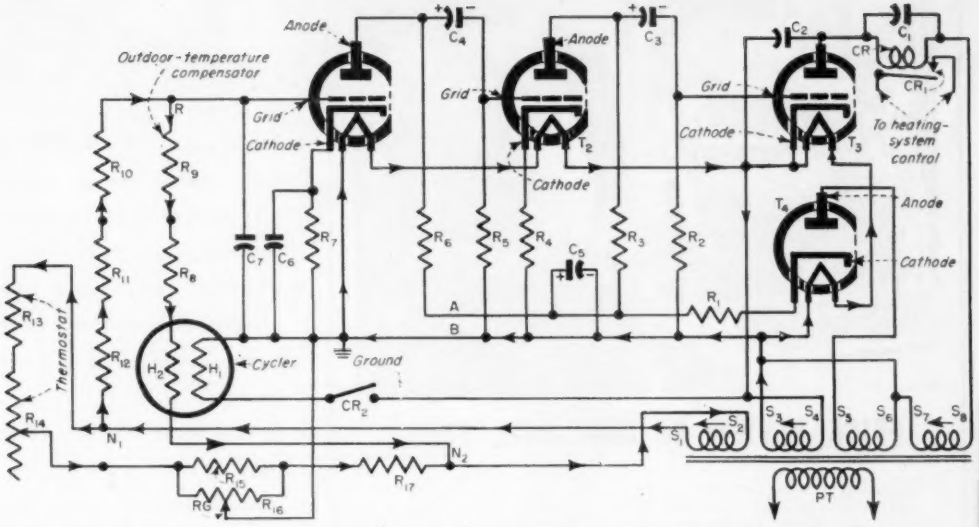
Fig. 2 diagrams a Minneapolis-Honeywell automatic electronic heating-system control (Moduflow). It includes sensitive resistance thermostats, R_{1a} and R_{1b}, connected in series. Averaging thermostat R_{1a} is a wire-wound-bobbin resistor to measure room temperature. The bobbin is wound with a special alloy wire that changes its resistance 1.2 ohms for each degree F temperature change on a 500-ohm bobbin.

This makes the thermostat sensitive to a small fraction of a degree temperature change. That is, a fraction of one degree is enough to turn on or off the heat sources, depending on direction of temperature change. The master thermostat resistor bobbin R_{1a} is similar to R_{1a} but has on it the day-and-night temperature adjustment.

Anticipator. Outdoor - temperature compensator (anticipator) R_3 measures the outdoor temperature. It contains a resistance bobbin similar to those in the thermostats and is mounted on an exposed outside wall of the building, preferably the north side, not in the direct sunrays. When outside temperature falls, the change in anticipator resistance raises room temperature one degree for every 38 F the outside temperature is below 70.

Relay CR has two contacts, CR_1 and CR_2. Closing of CR_1 turns on the heat, and CR_2, which for simplicity is shown away from the relay, energizes the cycler. The cycler determines the duration and frequency of the on heating cycle and provides a minimum on time of not less than 3½ min.

Heating load is constantly measured by the indoor thermostats and the outdoor anticipator. When the heating load is increasing, the cycler provides longer *On* and shorter *Off* periods for the heating source. Conversely, when the heating load decreases the *On* periods are shorter, the *Off* longer. When the heating load is constant, the cycler contact opens and closes at a frequency required to supply heat to the room as fast as it is lost to the outside, and thus



2 Changes in inside, outside and cycler temperature balance and unbalance the bridge voltages applied to grid of tube T_1. These voltage changes are amplified through tubes T_1, T_2 and T_3 to turn on and off the heat to hold the room constant

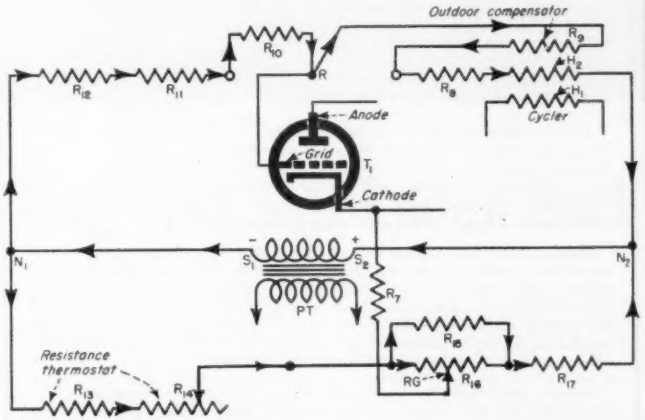
holds practically constant temperature.

Bridge Circuits. Thermostats R_{13} and R_{14}, outdoor-temperature compensator R_9 and cycler resistor H_2 are parts of a sensitive ac bridge. An ac voltage is applied across the bridge by transformer secondary S_1S_2. The grid and cathode of tube T_1 connect across the bridge from one end of R_9 at R to one end of the thermostats at RG on R_{16}.

Fig. 3 is a simplified diagram of the bridge circuits, Fig. 2. When the transformer secondary has the polarity shown, current flows from S_1 to N_1 through resistors R_{12}, R_{11}, R_{10}, R_9, R_8, and cycler elements H_2 to S_2. Another circuit is through thermostats R_{13} and R_{14}, resistors R_{15}, R_{16} and R_{17} to N_2 and S_2, as indicated.

Tube T_1 is connected across the bridge from R to RG so that voltage from R to N_2 across resistors R_9, R_8 and H_2 is applied from R to the grid and cathode of T_1 to RG, resistors R_7, R_{15}, R_{16} R_{17} to N_2. This voltage can be represented by curve AB_1C, Fig. 1A. Voltage from RG to N_2 across resistors R_{15}, R_{16} and R_{17} is applied from RG to cathode and grid of T_1 to R through R_9, R_8 and H_2 to N_2. Let curve ABC represent this voltage. On reverse transformer polarity the grid voltage cycles are completed and can be represented by curves CDE and CD_1E. Difference between these voltages is the effective bias on the grid of T_1 and is the signal, when amplified, that turns the heat on and off.

Incidentally, the bridge-circuit voltages are low. Voltage across the bridge from N_1 to N_2 is only 15 v. From R to N_2 and RG to N_2, volts drop is about 7.5 v so the maximum signal is only a fraction of a volt.

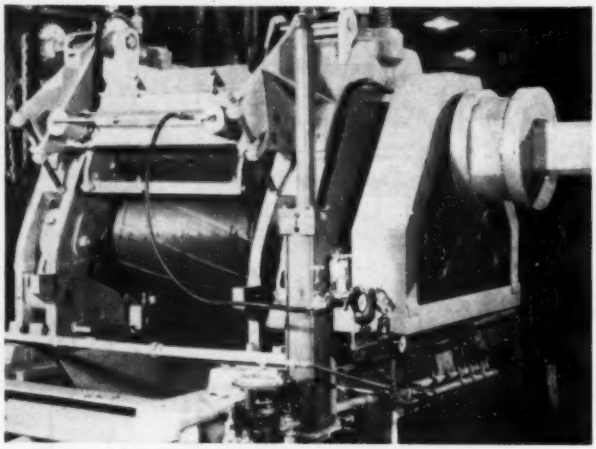


3 Simplified diagram of tube T_1 and bridge circuits, Fig. 2, to show how changes in bridge voltages because of temperature changes are applied to grid of tube T_1

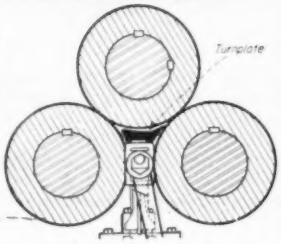
Thermostats. When the bridge is in balance, voltage from R to N_2 equals that from RG to N_2 as in Fig. 1A and there is no bias on the grid of tube T_1. The amplifier circuits, Fig. 2, are so arranged that when there is no bias on tube T_1, tube T_3 conducts to close relay CR to turn on the heat. A minus bias is required on the grid of tube T_1 to open relay CR and turn off heating system.

Assume room temperature controlled by thermostats only, outside temperature constant and that the thermostat in Fig. 3 has just turned on the heat, a condition represented by the voltage curves, Fig. 1A. After the heat is turned on, room temperature increases as does the resistance of thermostats R_{13} and R_{14}. As the thermostats' resistance increases, volts drop across them increases and decreases across resistors R_{15}, R_{16} and R_{17}, as shown by the curve ABC, Fig.

(*Continued on page* 196)



QUICK REVIEW OF CANE-MILL FACTS



Modern sugar-cane mills consist of three grooved *rolls*, with shaft centerlines at apexes of an isosceles triangle. Between two lower rolls is a *turnplate*. This directs *blanket* of fibers coming out of first set of rolls into second squeeze or *nip*. The rolls, cast-iron shells shrunk on alloy-steel shafts, are mounted in heavy sideframes (*headstocks*) bolted to rigid cast beds. Headstock construction is open so rolls can be removed readily. Bearings are usually open, watercooled and automatically lubricated.

Successful operation depends on nature of fiber to be milled. It must be strong enough in shear and tension to withstand pressure needed to crowd out liquid. Expressed liquid must be fluid enough so it can flow down the roll face ahead of the nip. If fiber isn't strong enough, it will be milled to a slurry and run off with the liquid. If the liquid is too viscous, slippage at the nip will be excessive and mill output will be reduced or even stopped by a *choke*.

Slippage is first consideration with an untried fiber. It is affected by the strength and length of fiber, for the nip creates tremendous pull. The greater the roll diameter, the more nearly vertical will be the entering pressure, with a smaller horizontal force acting in opposition to the flow of fiber. Feed angle and area of mill opening are less important factors. Helical grooves milled across the circumferential juice grooves (photo above) produce a hook-toothed surface to bite into slippery material without reducing extraction efficiency.

Hydraulic loading of top roll automatically adjusts mill to throughput. With heavy loads, top roll rises and passes a thicker blanket of cane with little or no loss in extraction efficiency. A quick-acting hydraulic jack under top-roll bearings relieves chokes; operating a 2-way cock lifts top-roll bearings.

Turnplate is a deep modified I-beam casting mounted between lower rolls. One of its jobs is to scrape the front roll; the other is to turn blanket upward through nip of the back roll. It can be tilted and slid fore and aft by an external adjusting mechanism. Upper surface curves to reduce pressure on blanket as it passes under top roll from first nip to second. There is from ½ to ¾ in. clearance between turnplate trailing edge and back roll. This allows for moving rear roll and makes a slot for second-nip liquid to pass to juice pan.

Grooving in sugar-cane mills varies from 2½ in. pitch to as little as ¾ in. Profile of juice grooves shows a 55-deg included angle at sharp root of groove and a 1/16-in. flat at outside diameter. This flat prevents the ragged edge likely with coarse-grained cast-iron used to give rolls a "wear rough" surface. The 55-deg angle is acute enough to cause cane fiber to arch the "V" with space below for liquid to escape. It also forms grooves deep enough to get the essential rubbing and cell-splitting action produced by closely pressed and mating rolls.

Scrapers or doctor blades are needed to keep rough surface of rolls clean so juice can escape. They are toothed to fit juice grooves and inclined at proper angle to shave off fibers with minimum friction and wear. Tips are renewable, though life is frequently as much as a year. Adjustable springs apply pressure to scrapers on top and rear rolls. Scraper tip for lower front roll bolts to turnplate.

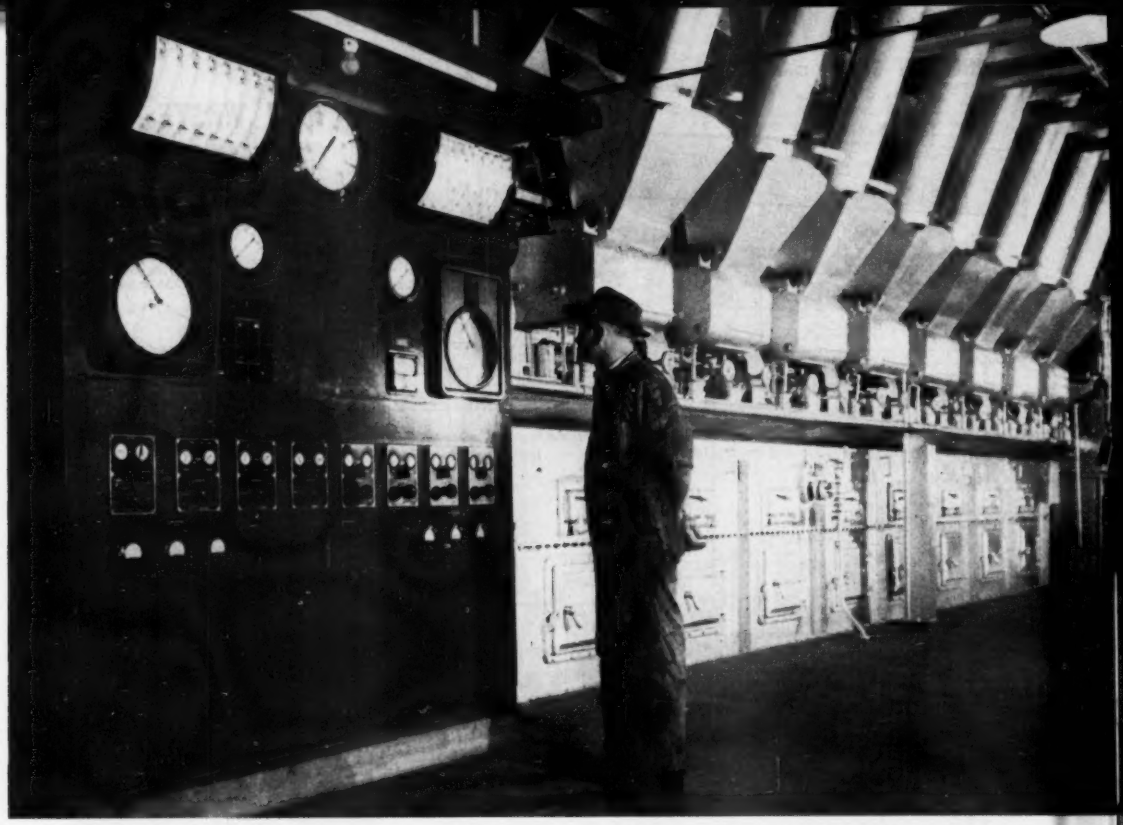
- **Sugar-cane mill adapted to press water out of waste fuel coming from hydraulic barkers . . .**
- **Shredded, dewatered fuel handled pneumatically from wood room to boiler house . . .**
- **Waste wood fired in suspension over coal - burning spreader stoker with traveling grate . . .**
- **These are just some of the reasons we say Columbia Cellulose Co Ltd's Prince Rupert pulp plant . . .**

Reveals New

By S B ROBERTS, *Chief Engineer, Celanese Corporation of America*

► NEW $27-MILLION wood-pulp plant of Columbia Cellulose Ltd at Prince Rupert, B. C., adds a much-needed source of raw material for the acetate yarns made by Columbia's parent company, Celanese Corp of America. But decision to build this first pulp plant to be owned by a chemical-fiber company posed problems for the engineers. Outstanding was the devising of satisfactory means for burning wet salt-laden bark from logs floated to the mill by sea.

Bark nuisance is turned into a profitable source of fuel in a fashion previously untried—a sugar-cane mill dewaters and shreds bark and hogged waste so it may be handled pneumatically and burned in suspension. Our experience with these mills, little known outside the sugar industry, began in 1932. We have since installed 17



FIRING AISLE in front of one of the two 250,000-lb-per-hr boilers shows spreader-stoker feeders, boiler control panel

Slants on Burning Wet Salt-Laden Bark

specially designed 3-roll cane mills for expressing free water from industrial fibers. Thus it was natural to try dewatering West Coast bark in one of them when, in 1947, we began looking into fuels for the projected pulp mill. Such mills are rugged, low in upkeep cost; we expected to cut moisture to less than 50% (see panel, *left*).

Mill selected after experimental work is a Squiers 18 x 30-in. (roll diameter and length) running at 35 fpm. On the basis of our experience with bagasse and other fibers, we selected ½-in. pitch for the mating circumferential juice grooves. This spacing is fine enough to give good dewatering and coarse enough to take a 2-in. plank if need be. Helical grooving and auxiliary force-feeding roll is also supplied. Rolls are cast iron, best for bark. Top roll is driven through a coupling; it drives two other rolls through gearing. Hydraulic pressure on top roll reaches 125 tons.

In adjusting this mill, we set rear nip (see panel, *left*) iron-to-iron and opened up first nip to about ¾ in. Curve of turnplate top is generally a logarithmic spiral. Considerable water is removed as blanket of fibers crowds across this stationary surface. Blanket is being pushed by first nip, frictioned against turnplate and moving top roll. Meanwhile blanket is being upset by expanding passage just ahead of second nip.

If turnplate is set too high, horsepower becomes excessive. Also, pressure in confined space pushes up against top roll in opposition to hydraulic pressure which creates the powerful nips. If turnplate is set too low, blanket is not continuous and back-roll operation becomes irregular. So it is customary to set toe of turnplate below top-roll periphery a distance about twice mill opening; drop heel as much as ½ in.

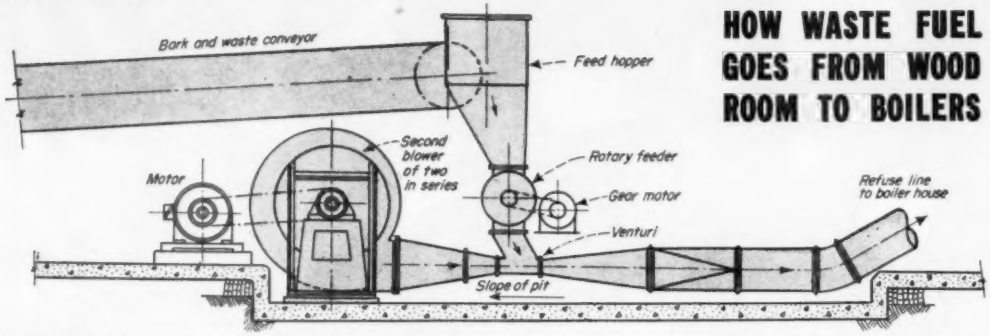
Cane mill at Prince Rupert is driven by a 150-hp 1800-rpm wound-rotor motor. Gear train is a triple-reduction herringbone unit with ratio of 118.75 to 1. Motor drives reducer through V-belting. Mill speed can be doubled by changing V-belt sheaves when, and if, plant is extended.

Weight of bark per bd ft of log given by various authors varied so much we ran a careful trial on 27 run-of-mill hemlock logs. Western hemlock is principal species at Prince Rupert, although there is some spruce and fir. All waste was weighed; bare logs were measured. Results were as follows:

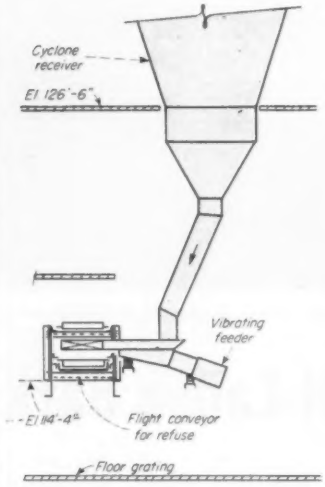
Tally of 27 logs, BC board ft	8227
Calculated volume bare logs, cu ft	1105
Total log surface, sq ft	2702
Weight of bark and trash, lb	4440
Weighed waste compared to solid wood, assuming 44 lb per cu ft, %	13.2
Density bark after mill, lb/cu ft	23.3
Density of chip fines, lb/cu ft	19.3
Waste to boilers, lb/BC bd ft	0.76
Cane-mill throughput, lb/hr	15,000
Htg value wood waste, dry Btu/lb	9400
Net htg value, as fired, Btu/lb	4870

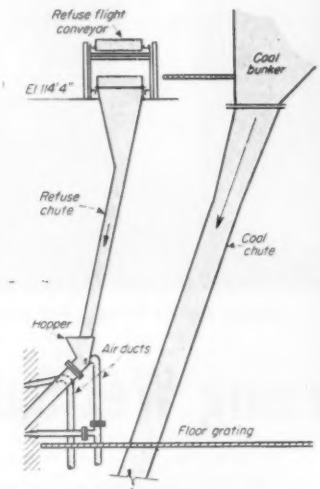
(*More on next page*)

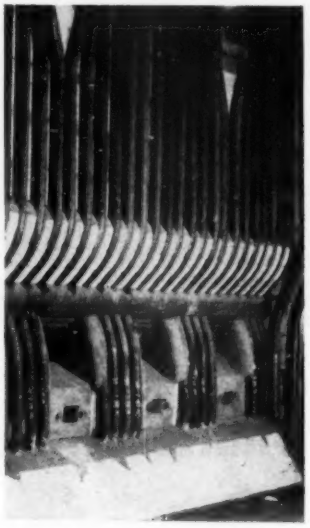
HOW WASTE FUEL GOES FROM WOOD ROOM TO BOILERS



PNEUMATIC CONVEYOR receives shredded, dewatered bark from cane mill via belt conveyor and rotary feeder. Two vane-type blowers in series handle air only. Air stream picks up bark and conveys it about 500 ft to a cyclone in the boiler house







CYCLONE stands above horizontal flight conveyor serving chutes to the furnaces

BARK CHUTES ENTER FURNACE above spreader feeders. Air jets are for emergencies. Photo shows how front waterwall tubes bend to admit 6x12-in. bark chutes

Due apparently to less gum and resins, or more water, West Coast hemlock mills much better than Eastern bark run in Squiers pilot plant. Dirt and sand has been largely lost during salt-water storage and in hydraulic barker. No appreciable moisture loss through pneumatic conveyor was observed.

Dripping-wet bark from the hydraulic barker, with sawdust, knots, and wood-room trash, is delivered to a hog and then to the cane mill by conveyors which run continuously while wood room is operating. Shredded and dewatered product from cane mill then goes to a hopper over a star-type rotary feeder which discharges into a low-pressure pneumatic conveyor. This sends waste fuel from wood room to a cyclone in the boiler house, through 500 ft of 17-in. diameter 10-gage steel duct.

Pneumatic System. Two vane-type blowers, in series, handle conveying air only. Velocity of blast from second blower is increased to about 23,600 fpm in a special venturi (diagram above) to produce a slight negative pressure at throat where bark enters conveyor. Designed on a basis of 1.5 lb air per lb wood waste, blowers are rated at 9350 cfm. A 60-hp 1750-rpm motor belt drives each at 1530 rpm. Static pressure after second blower at rated load of 14 tons per hr of 50% moisture refuse, is designed to be 42 in. water. We have, however, been able to carry heavy loads with only one blower energized. Under that condition, suction at bark inlet ran 23 in. and discharge at fan 25 in., making 48 in. total head.

Duct layout features: no vertical risers, maximum slope 7 in 12, only four bends ranging from 23 to 30 deg, design velocity of 6000 fpm, ample clean-outs. In event of a choke, flutter vane at first blower's inlet switches off motor on supply conveyor.

Either of two boilers can take all bark, so we provided no holding bins. There is, however, a 17-in. dia bypass duct, 275 ft long, to outdoor storage for use if main duct chokes. This storage can be reached by bulldozer for delivery to coal elevator.

Why Pneumatic? For this particular

arrangement of buildings and equipment, investment for pneumatic conveyor proved less than for belt conveyor with which we compared it. Much of run is outdoors and annual rainfall is about 100 in. Less-important expected advantages for pneumatic system are: lower maintenance and some additional drying from evaporation into conveying air. Power requirements are, however, higher. Use of preheated air or flue gas offers possibilities for further reducing bark moisture.

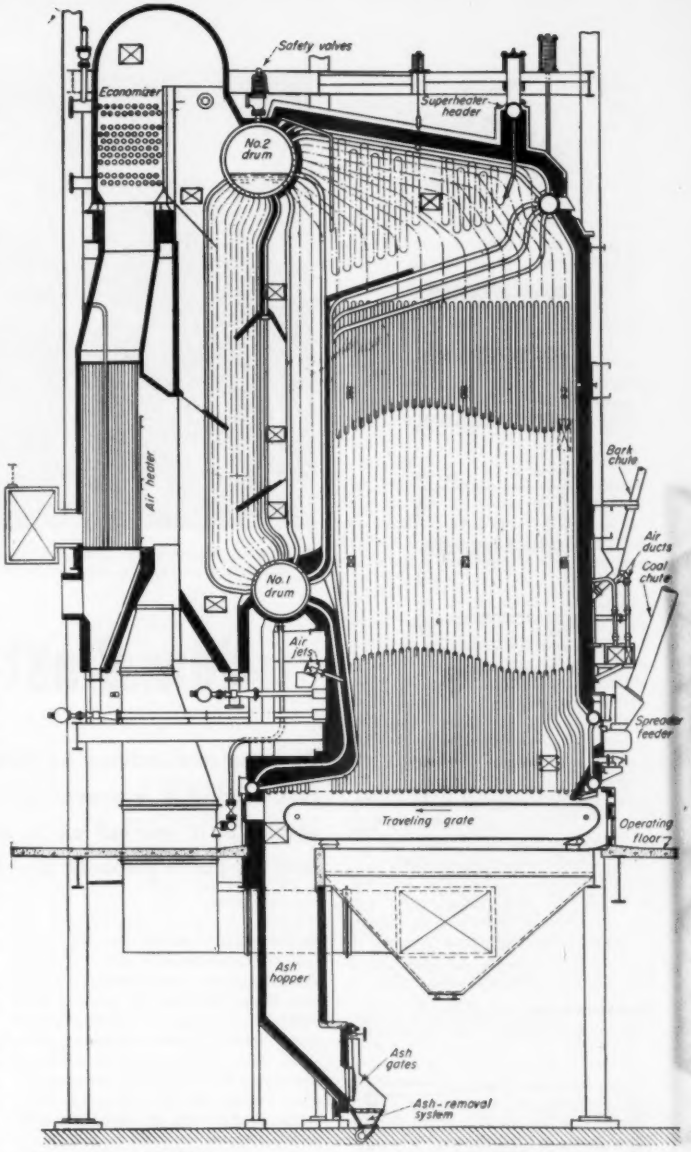
Cyclone Separator. Conveyor duct discharges into a cyclone 69 ft above inlet to first blower. Design pressure drop, for full flow, is 2.5 in water. A 17-in. dia bottom discharge leads to a vibrating-pan feeder which serves four purposes: (1) prevents accumulation of bark and possible choking in cyclone's lower cone (2) provides a partial air seal at discharge (3) moves material horizontally from cyclone to lower flight of drag conveyor (4) loads conveyor evenly across its width.

This Jeffrey pan feeder is magnetic: amplitude and feed rate can be changed by controlling mg set energizing it. Feeder discharges into a 24-in. horizontal flight conveyor in front of boilers. Eight chain-operated slide gates serve the four inclined bark chutes to each of 2 boilers. Gates are adjusted by hand so bark is distributed equally among active furnace chutes.

Controls. A Fuller bin-level indicator warns operator if cyclone begins to accumulate bark. Entire bark system is electrically interlocked so failure of one unit shuts down all equipment back of it to first conveyor under barker pit. Rotary feeder, blowers, piping and cyclone were designed and built by Day Co of Canada, Ltd.

Front waterwall tubes of each boiler bend to admit four 6 x 2-in. bark chutes which enter at 45 deg, 12 ft above grate (photo, *left*). Chutes have a top-hung swing damper to reduce air infiltration. Weight of bark (about 23 lb per cu ft) pushes these dampers open. Lower ends of chutes, which see the fire, are stainless steel. Jet of low-pressure air at bend in bark chute and another under lower end provide for emergencies. Chute observation port can also be used as a roust hole to clear a blockage or scrape coke from fireside of chute if it should form.

Boiler Capacity. Calculated plant steam demand set rating of the two boilers at 250,000 lb per hr for 4 hr, and 180,000 lb continuous. Steam conditions of 600 psig and 750 F yield a turbine steam rate to match plant's steam-electric balance. Double automatic-extraction turbine-generators are installed; one has a condenser.



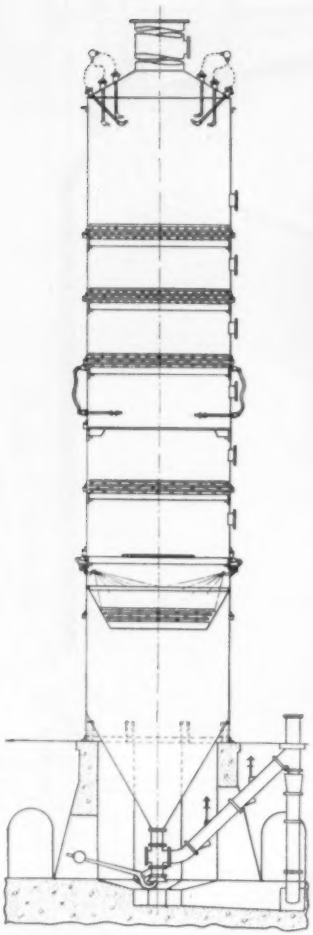
WATERWALLED BOILERS have a 4-hr rating of 250,000 lb per hr at 600 psig, 750 F

Fuel Consideration. For this plant, Telkwa, B. C. coal was indicated as probable basic fuel, although we made provision for burning oil with minor changes when and if, oil became the cheaper fuel. Early discussions on bark burning indicated a preference on the part of boiler manufacturers for use of conventional Dutch-oven furnaces. We concluded that cost and maintenance would be too high for separate furnaces on this particular job.

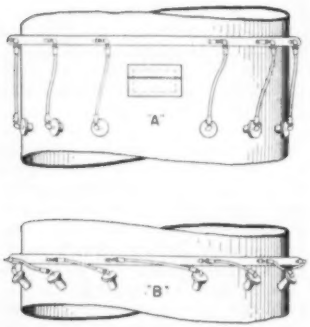
From experience, we were convinced that, like bagasse in a cane factory, milled bark could be chuted high up in a furnace and would burn in suspension over another fuel. Also, that with properly adjusted chute flaps excess air would not be a serious problem.

In the end, we discarded a recommendation for pulverized coal because coal received at Prince Rupert is normally extremely wet, with poor grinda-

(*Continued on page* 212)



TOWER WASHER, 18 ft dia, 95 ft high, reduced dust loading of raw incoming gas



SPECIAL circular headers spaced up the tower, above, supply water to jet sprays

1 Recent steel-industry power plants put in special blast-furnace-gas cleaning equipment to prepare this byproduct fuel for direct use in their new boilers

Now Blast-Furnace Gas

Once the steel industry handled blast-furnace gas as a waste fuel, worked it wherever possible. Today, with full-capacity output it is counted on to carry base-load plants. Here's how the gas is prepared, and how it fits into the new plants

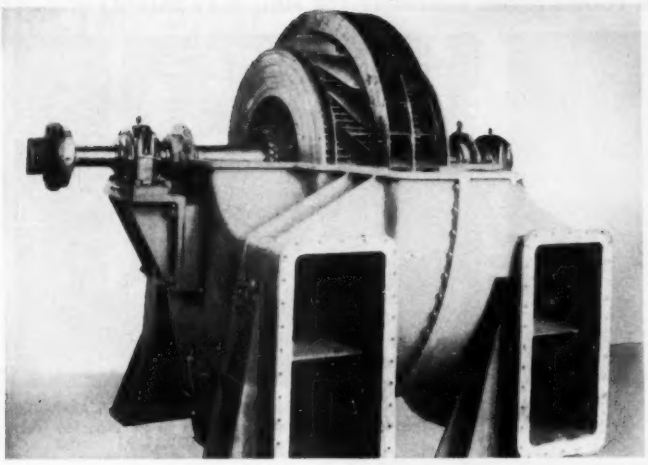
► THE STEEL INDUSTRY along with most industrials has found its electric-energy demand growing fast while its fuel costs stay high. One way of meeting both problems is to go to higher-pressure steam with a turbine-generator, operating from the new pressure level and exhausting to the normal pressure for plant steam load. Electric-energy costs at the busbar run relatively low with such a scheme.

The more recent power plants going into the steel industry have adopted this method to a fairly large extent. But in addition they are using one of their principal byproduct fuels, blast-furnace gas, to develop this high-pressure steam. It results in the cheapest possible electric-energy costs.

It makes sense to use the lowest-cost plant to carry the base load, but is it possible for the industry to adopt these new low-operating-cost plants to base-plant service, using blast-furnace gas as a fuel? In the past this gas was usually considered very dirty, and boilers firing it were expected to have high maintenance costs and low availability. Today, though, that's no longer the case. A typical new steel-mill power plant, (photo, above,) will show best what changes have taken place.

Cleaning Gas. The new high-pressure boilers now handle only clean gas. This gas has: (1) Btu content of about 100-110 per cu ft depending on its source (2) dust content of less than 0.01 grains per cu ft (Table I, on p 98), which compares very favorably with the typical raw blast-furnace gas of 2-4 or more grains per cu ft. Here is how the cleaning is done.

The raw gas coming off the furnace, Table I, goes to a tower washer, diagram at left. If it comes from a furnace under manganese operation, it passes through two towers in series. From a basic furnace, it goes through only one tower. These towers measure 18 ft in diameter and stand 95 ft high. They are made of steel plate and filled with a grid of 2-inch pipes. (Usually



2 Mechanical disintegrator, an induced-draft fan equipped with water sprays, further reduces dust loading of gas leaving tower washer, diagram on facing page

ls Base-Load Boiler Fuel

these towers are of similar design but may use wood grids instead of steel pipe.) The lowest section of pipes are put in on 8-in. centers, the central section on 6-in. centers, and the top on 4-in. centers.

Spaced up the tower, sketches *A*, *B*, facing page, are circular headers supplying water to opposed jet sprays. The sprayed water falls on the pipe surfaces, wets them, and then falls down to hit lower pipes and break up again. The whole idea is very similar to a cooling tower.

Water collects at the bottom of the tower and runs off through a drainage system. A water seal made up of the drainage piping prevents any gas leakage. A flush-out valve, set directly below the tower base and tapped into the drainage system, permits removal of any solid buildup in the drainage pipe. Some plants have the drainage system discharge to sumps and from there to Dorr thickeners to reclaim the solids.

The incoming raw blast-furnace gas enters at the bottom of the tower at roughly 31-in. wg and passes upward through the downcoming water spray. It leaves from the top of the tower at a pressure of 26-in. wg. The dust content has been greatly reduced. For a basic furnace gas, it runs as low as 0.2 gr per cu ft after passing through one tower. For a manganese gas, after passing through two tower washers in series, it shows a 1.5 gr per cu ft dust content.

Secondary Cleaning. The discharged gas goes to a common gas header, called the primary cleaned gas main, where the basic gas and manganese gas are mixed. The gas flows from the primary cleaned-gas main into the secondary gas inlet, which here is a mechanical disintegrator, Fig. 2. The disintegrator is essentially an induced-draft fan equipped with water sprays, which serve to produce intimate contact between the dust particles and the water. The water droplets, containing the entrapped dust, are thrown out to the edge of the fan scroll by centrifugal force and pass through a water seal on their way to the sump.

In addition to separating entrained dust in the blast-furnace gas, the disintegrator adds some entrained moisture to the saturated gas as received from the primary wash towers. So a moisture eliminator consisting of a series of baffles is put in the path of the leaving gas to remove most of the entrained moisture. The output for an average gas, Table I, contains 110-115 Btu per cu ft; has under 0.01 gr per cu ft, and is at about 125 F under a pressure of about 26 in. wg.

Changing Gas. Btu content and volume of gas reaching the boiler plant depends on the nature of the raw blast-furnace gas and furnace size. Volume of gas produced by the furnaces in question is approximately 3,200,000 cfh when producing ferro-manganese, and about 4,000,000 cfh when on basic iron. Btu content, temperature, pressure and dust loadings of these gases are tabulated in Table I. Blending or mixing of the two types of gas is accomplished in the primary washed-gas main and the secondary gas cleaners. Gas is considered completely mixed when leaving the secondary cleaners.

So the gas may range in Btu content from about 115, with roughly equal proportions of basic and manganese furnace gas, to about 100 with 100% basic furnace gas.

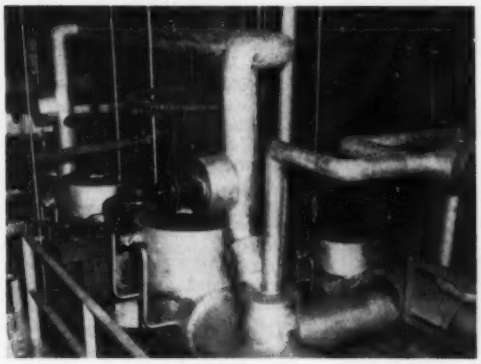
Fan Loading. As might be expected, this possible swing in heat content of the fuel has its effect on boiler-plant equipment design. Table II shows the expected load and operating figures for the induced-draft fans going into our typical, recent power plant, Fig. 1.

While the design figures for the induced-fan brake horsepower range from 58 with a 150,000-lb-per-hr steam load and a 125-Btu gas to a tops of 867 for a 98-Btu gas and a 250,000-lb-per-hr steam load, actual operation lies well within this range. Reasons for this are (1) the common secondary cleaning of a mixture of basic and manganese gas, and (2) the fact that normal plant operation consists of more basic furnaces than manganese furnaces.

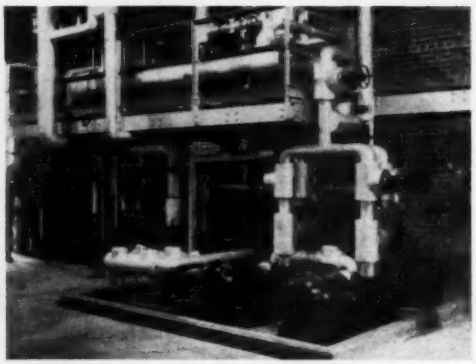
Boilers in this particular plant, Fig. 1, are tangentially fired watertube units. They can develop up to 250,000 lb per hr of steam at 850 psi, 850 F. They handle blast-furnace gas principally with fuel oil as a supplement. Separate steam-atomizing oil burners are inserted in the tangential burners if gas supply runs low.

Load Scheduling. Problem of scheduling a boiler house for base-load operation with blast-furnace gas is an interesting one. The scheduling of gas to the various consumers is the function of the gas dispatcher. Volume of gas available for power generation varies with the blast-furnace operations. The gas dispatcher, with a full knowledge of furnace operations, and the assistance of a gas holder, schedules the flow of gas to the boilers. The boiler operator, having been advised of the quantity of gas available, and with knowledge of the scheduled steam load, supplements the gas with fuel oil whenever necessary to maintain full steam pressure against the turbine throttle.

What happens when the output of gas falls below the expected level? In most installations there is no automatic switchover to fuel oil. So as soon as the



3 Higher-pressure steam generation with its exhaust to lower-pressure mill equipment gives a low-cost electric energy



4 Oil-burning equipment permits automatic switchover to oil if output of blast-furnace gas falls below expected level

I: GAS CLEANING RESULTS, PRIMARY AND SECONDARY WASHERS

	Dust Cont, Gr Cu Ft		Btu Content		Pressure in Wg		Temp, Deg F	
Basic gas	*Enters*	*Leaves*	*Enters*	*Leaves*	*Enters*	*Leaves*	*Enters*	*Leaves*
Primary	1.75	0.2	100	100	31	26	300	125
Secondary	0.2	0.007	100	100	22	26	125	115
Manganese gas								
Primary	4.5	1.5	125	125	31	26	500	125
Secondary	1.5	0.007	125	125	22	26	125	115

II: FUEL EFFECTS ON LOADING OF INDUCED-DRAFT FANS

Boiler Load	*250,000 Lb per Hr*			*200,000 Lb per Hr*			*150,000 Lb per Hr*		
Gas quality, Btu	125	109	98	125	109	98	125	109	98
Flue-gas volume, cfm	201,000	222,000	263,000	148,000	161,000	188,000	102,000	115,000	132,000
Flue-gas temp, F	489	510	528	447	467	486	394	415	533
Static press. in. wg	8.1	9.9	13.6	4.6	5.6	7.3	2.3	2.8	3.7
Fan speed, rpm	523	583	688	383	431	491	264	296	342
Fan brake, hp	400	533	867	167	226	334	58	80	120

operator spots a drop in steam pressure he checks the static pressure on the incoming blast-furnace gas line. Then he inserts the separate steam-atomizing oil burners mentioned above to bring up boiler pressure.

Operating Results. To date experience with clean gas-fired boilers has been excellent. Often there is no soot-blowing program as such. Soot blowers are often installed, but as a rule they are used much less often than is usual in power-plant practice. Boilers operate for a full year, and come off the line only for scheduled annual inspection.

Previously blast - furnace - gas - fired boilers had to be shut down every three to six months for cleaning. Some external dust-collecting means had to be devised for cleaning stack gases.

Even with the added expense of gas cleaning the cost of generating steam per 1000 lb shows an estimated saving from 8 to 10c over the uncleaned gas.

New Power Plant. In addition to the two 250,000-lb-per-hr 850-psi 850-F steam generators there is a 7500-kw 25-cycle turbine-generator exhausting at 165 psi. In effect it is a topping turbine since the 165-psi pressure is the normal-plant steam-load pressure.

Both the induced-draft fans and the boiler feed pumps work off the 850-psi pressure header. They exhaust at 5 psi and supply steam to a deaerating feedwater heater to maintain its temperature at 220 F.

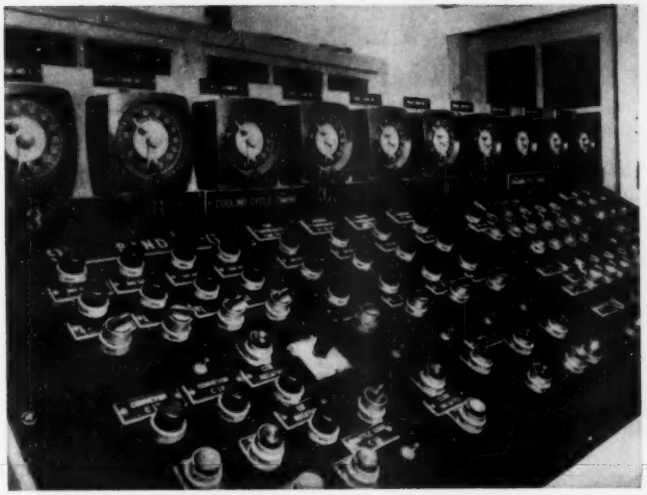
A pressure-reducing valve between the 850-psi level and the 165-psi exhaust gives a definite flexibility to the high-pressure steam cycle. It permits delivery of steam direct to the usual plant-process level so boiler output need not depend on turbine-generator needs alone.

Water Treatment. Makeup water for the high-pressure boilers is made up of condensate return from various low-pressure steam drives throughout the mills. This gives as clean a water as possible under the topping-turbine scheme of operation.

All raw boiler feedwater entering the system goes through sand filters to remove turbidity, and is further treated in zeolite softener before being used as makeup in the low-pressure boilers. Condensate from low-pressure condensing turbine-generators and blast-furnace turboblowers is returned to a surge tank at the high-pressure boilers and thence to a deaerating heater. The boiler feed pumps draw the heated water from the heater, and raise the pressure to approximately 1000 psi. At the pump inlet about 0.5 ppm of sulfite and 0.5 to 0.7 ppm of caustic is added. Also about 0.5 ppm of phosphate is added in the boiler drum. The phosphate is added in the drum rather than at the feed pump to prevent formation of pump phosphate sludge in the economizers.

700-Ton Plant Cools Huge Detroit Dam

Refrigerating plant will cool everything going into concrete mix to hold it below 50 F, while poured into great dam and 140,000-hp plant



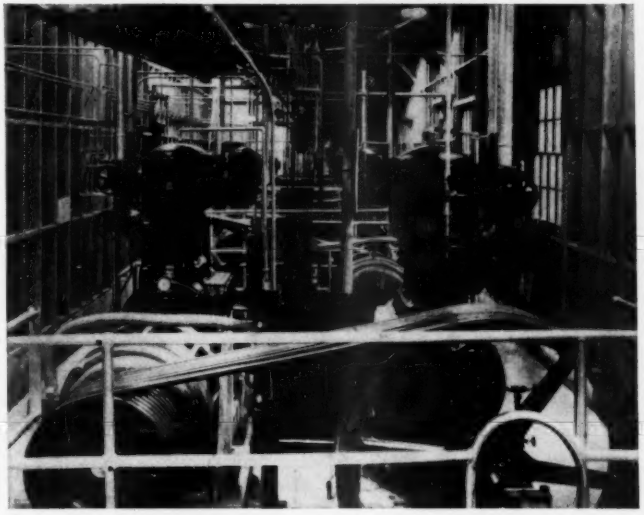
1 CONTROL BOARD. All cooling operations and the concrete mixing are electrically controlled by switches on these panel boards, in a tower overlooking project

► GRAND COULEE and Bonneville dams on the Columbia River in the Pacific Northwest have attracted so much attention that other great works get scant consideration. Such a venture is the $70,000,000 Detroit dam and power project being built by the U. S. Corps of Engineers. It is about 87 miles south of Portland, Ore., on the North Santiam, a tributary of the Willamette.

High Dam. North Santiam River has its source in Santiam Lake near the summit of the Cascade Mountains, 5100 ft above sea level. This 89-mile-long river falls 4880 ft, and drains 760 sq mi, of which 438 are above the Detroit dam site. Here a gorge in the Cascade Mountains makes it possible to build a dam 463 ft high, 330 ft thick at the base, with a crest length of only 1580 ft. It will form a reservoir with a usable capacity of 340,000 acre-ft.

A powerhouse built into the toe of the dam will have two 70,000-hp turbines driving 55,555-kva generators. Operating head will range from 375 to 225 ft. In this construction the dam and powerhouse will require 1,500,000 cu yd of concrete and 3750 tons of steel.

Cooling the Concrete. To keep stresses low in the concrete while it is setting, everything that goes into the mix is cooled. Maximum concrete temperatures cannot exceed 50 F when poured. After being washed and screened, the stone is cooled in large tanks through which 35-F water circulates. Grit is allowed to separate from the water in special settling tanks. This water is cooled again in three shell-and-tube vessels, each 30 in. in diameter by 18 ft long, containing 298 tubes of 1¼-in. dia. Each shell has a float-valve control and an oil-type liquid-level gage.



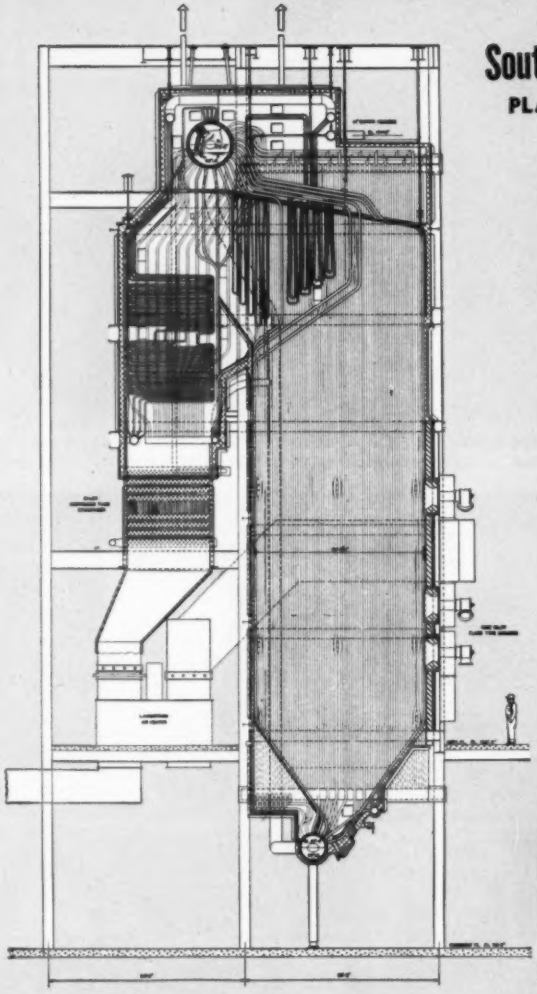
2 REFRIGERATION PLANT. Seven motor-driven compressors deliver 700 tons of refrigeration to cool concrete, crushed stone, cement, water before going into dam

Sand and cement are cooled in a series of jacketed troughs, through which they are passed by screw conveyors having hollow vanes. Water for mix is cooled to near freezing in two shell vessels, 10 in. dia by 15 ft long, each containing 31 tubes 1¼ in. dia.

To do this cooling requires a 700-ton refrigerating plant that has six Frick 9x9-in. machines and one 8x8-in. All are driven at 400 rpm through V-belts by Ideal 100-hp motors. Three condensers are shell-and-tube type, 24-in. in diameter by 15 ft long, supplied with water from the river by 1200-gpm pumps. Entire operation of cooling and mixing the concrete is electrically controlled from switches on a panel board in a tower overlooking the project.

Project is being built under contract by Consolidated Builders, Inc. Contract for the cooling equipment was awarded to Lewis Refrigeration and Supply Co, Frick sales representative in Seattle.

South Carolina Installing Their



South Carolina Electric & Gas Co.

PLANT HAGOOD, CHARLESTON, S. C.

Gilbert Associates, Engineers

Capacity	400,000 lbs./hr.
Design Pressure	1475 psig
Steam Temperature	955°F.
Exit Gas Temperature	330°F.
Temperature Air	600°F.
Efficiency	87.1%

Initially Oil Fired—Future Pulverized Coal

HEAT BALANCE

Dry Gas Loss	5.06
Hydrogen and Moisture Loss	5.82
Moisture in Air Loss	0.12
Radiation Loss	0.40
Manufacturers Margin	1.50
Total Losses	12.90
Efficiency	87.1%

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Charleston, S. C.
400,000 lbs./hr. Riley Unit

First Unit at Plant Hagood. Second Unit has been added. Third Unit being installed.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston Denver
Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Third Riley Unit at Plant Hagood

When South Carolina Power Company built Plant Hagood back in 1946, a 230,000 lbs./hr. 975 psig 860°F. Riley Steam Generating Unit was selected for unit No. 1. In 1948 when unit No. 2 was added, a duplicate Riley unit was ordered. Last year, another Riley unit—400,000 lbs./hr. 1475 psig 955°F. unit was ordered as unit No. 3.

After a company has operated Riley equipment, they almost invariably order additional Riley equipment when additional units are added. Public Service Company of Indiana, for instance, has ordered 7 Riley units; Iowa-Illinois Gas & Electric, 6 Riley units; Interstate Power, 7 Riley units; Houston Lighting & Power Co., 9 Riley units; Utah Power & Light, 4 Riley units; Central Ohio Light and Power, 5 Riley units.

The regularity with which Riley Steam Generating unit users repeat for additional Riley units when plants are expanded is positive proof of the excellent performance of Riley units—their reliability and continuity of service and the satisfactory service rendered by the Riley organization.

All of these public utilities have ordered Riley Steam Generating Equipment:

THE POTOMAC EDISON CO.	
Albright Station	1–700,000 lbs./hr.
IOWA ELECTRIC LIGHT & POWER CO.	
Boone Station	1–275,000 lbs./hr.
NORTHERN STATES POWER CO.	
Granite Falls Station	1–385,000 lbs./hr.
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY	
Monck's Corners Station	2–460,000 lbs./hr.
MONONGAHELA POWER COMPANY	
Albright Station	1–700,000 lbs./hr.
SUPERIOR WATER, LIGHT & POWER CO.	
Superior Station	1–125,000 lbs./hr.
HOUSTON LIGHTING & POWER CO.	
Gable Street Station	1–140,000 lbs./hr.
Gable Street Station	1–250,000 lbs./hr.
Gable Street Station	1–350,000 lbs./hr.
Greens Bayou Station	2–675,000 lbs./hr.
West Junction Station	2–400,000 lbs./hr.
West Junction Station	2–825,000 lbs./hr.
PUBLIC SERVICE CO. OF INDIANA	
Dresser Station	1–300,000 lbs./hr.
Edwardsport Station	3–400,000 lbs./hr.
Noblesville Station	3–300,000 lbs./hr.
NORTHERN VIRGINIA POWER CO.	
Riverton Station	1–350,000 lbs./hr.
CENTRAL ILLINOIS LIGHT CO.	
R. S. Wallace Station	1–600,000 lbs./hr.
R. S. Wallace Station	4–300,000 lbs./hr.
ARKANSAS POWER & LIGHT CO.	
Cecil Lynch Station	1–650,000 lbs./hr.
UTAH POWER & LIGHT CO.	
Orem Station	1–450,000 lbs./hr.
Jordan Station	1–620,000 lbs./hr.
Jordan Station	1–575,000 lbs./hr.
WORCESTER COUNTY ELECTRIC CO.	
Webster Street Station	1–325,000 lbs./hr.
WEST PENN POWER CO.	
Milesburg Station	2–210,000 lbs./hr.
INTERSTATE POWER CO.	
Dubuque Station	1–200,000 lbs./hr.
Lansing Station	2–120,000 lbs./hr.
Fox Lake Station	2–120,000 lbs./hr.
Clinton Station	1– 45,000 lbs./hr.
NEW ORLEANS PUBLIC SERVICE CO.	
Market Street Station	1–330,000 lbs./hr.
IOWA-ILLINOIS GAS & ELECTRIC CO.	
Riverside Station	3–250,000 lbs./hr.
Cornlville Station	1– 60,000 lbs./hr.
Moline Station	2–200,000 lbs./hr.
CITY OF LOS ANGELES	
Harbor Steam Station	3–825,000 lbs./hr.
Harbor Steam Station	2–675,000 lbs./hr.
MISSISSIPPI POWER CO.	
Plant Eaton	3–230,000 lbs./hr.
OTTER TAIL POWER CO.	
Kidder Station	2–100,000 lbs./hr.
Crookston Station	2– 75,000 lbs./hr.
Devils Lake Station	1– 75,000 lbs./hr.
Canby Station	1– 75,000 lbs./hr.
OHIO EDISON CO.	
Mad River Station	1–250,000 lbs./hr.
SOUTH CAROLINA POWER CO.	
Plant Hagood	2–230,000 lbs./hr.
Plant Hagood	1–900,000 lbs./hr.
GULF POWER CO.	
Pensacola Station	2–230,000 lbs./hr.
Pensacola Station	1–325,000 lbs./hr.
UNION ELECTRIC CO. OF MISSOURI	
Ashley Street Station	2–285,000 lbs./hr.
Ashley Street Station	3–310,000 lbs./hr.
CENTRAL OHIO LIGHT & POWER CO.	
Woodcock Station	2–120,000 lbs./hr.
Woodcock Station	1– 90,000 lbs./hr.
Woodcock Station	2– 60,000 lbs./hr.
PENNSYLVANIA ELECTRIC CO.	
Williamsburg Station	1–300,000 lbs./hr.
CAROLINA POWER & LIGHT CO.	
Moncure Station	2–330,000 lbs./hr.

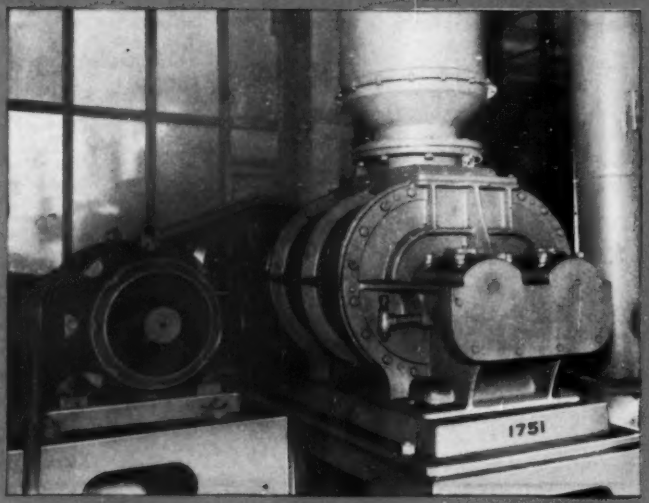
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

NO V-P-L WORRIES WITH R-C BLOWERS



ROTARY

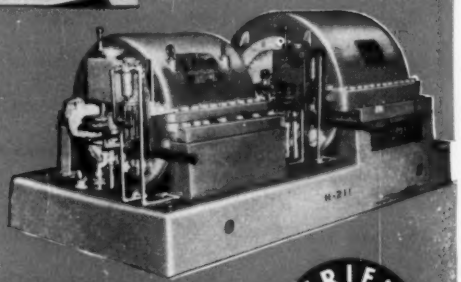
Rotary Positive Blower for pneumatic conveying in large eastern processing plant. Many other R-C units are used in various plants of this same company.

Today's production urgencies call for "no-vacation" performance from blowers and other equipment to move gas and air. You must be sure of positive Volume, at the required Pressure, and at low power cost to keep down rising expenses. The answer is Roots-Connersville Blowers with V-P-L.

You obtain this freedom from worry whether you install R-C Centrifugal or Rotary Positive equipment. This exclusive *dual-ability* gives you the choice of either type to best meet your requirements. Wide latitude in sizes, from 5 cfm to 100,000 cfm, permits selection of units with capacities close to your specific needs. Often, this flexibility saves time, cost, space, weight and power charges.

R-C engineers will gladly counsel with you on any problem of moving or measuring gas or air to keep production going.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Powell Avenue, Connersville, Indiana



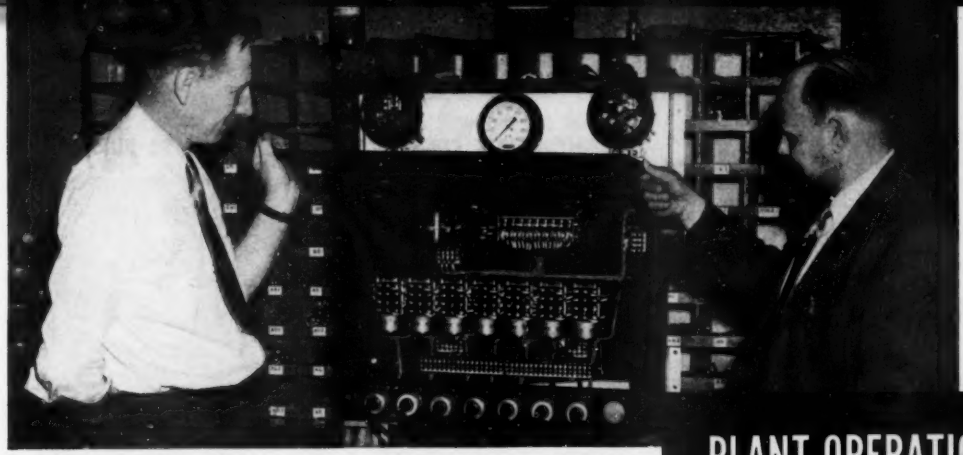
Two, 4-Stage, Type H Centrifugal Compressors, mounted on common base. Motor driven, with capacities of 11,230 cfm and 8,990 cfm, respectively.

CENTRIFUGAL

ROOTS-CONNERSVILLE

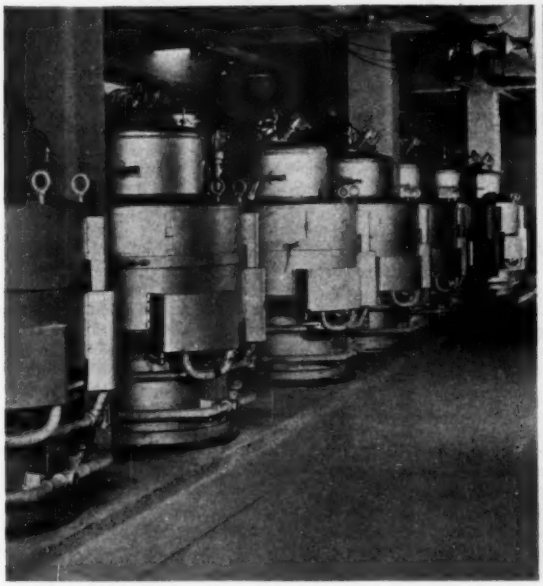
BLOWER BUILDERS SINCE 1854

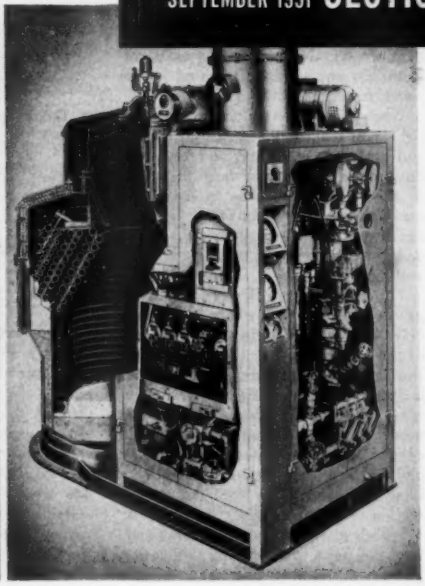
ONE OF THE DRESSER INDUSTRIES



1 Specially designed master control panel, *above*, turns seven packaged, forced-circulation boilers, *below*, on or off one at a time according to pressure changes to supply steam and heating load in new Union Pacific Railroad laundry, at Ogden

2 Forced-circulation steam generators have 700 ft of seamless-steel tubing, serving as steam-generating surface. Heat release in furnace runs about 1,000,000 Btu per hr per cu ft, when burning No. 2 fuel oil. Fully automatic. *Below, right*.





Those seven steel "kegs" above are boilers. Standing only 6½ ft high, they use forced circulation to make the U-P laundry . . .

Compact, Quick-Steaming Honey of a Plant to Run

► Union Pacific Railroad's new laundry at Ogden, Utah, is built around seven 4500-lb-per-hr, packaged, forced-circulation boilers—something new in the small stationary field. This isn't quite the gamble it sounds. Behind the selection stand 15 years of experience with this class of boilers, supplying passenger-car heating for diesel streamliners. Union Pacific's *City of Portland* put in the first design of the Vapor Clarkson steam generator back in 1936.

Today's model, Fig. 2, is a high-ef-

ficiency (80%) unit, fully automatic, with a reputation for reliability. It takes up a space only 76 in. long, 52 in. wide, 78 in. high, and at Ogden is used to develop steam at 100 psi. With relatively few changes this same unit can produce steam up to 600 psi.

Water Cycle. Heart of the steam-generating surface is 700 ft of seamless-steel tubing, Fig. 2, built to withstand a 1200-psi hydrostatic test. Controlled incoming feedwater flows through a lift check valve (prevents generator steam pressure from backing into the feedwater heater, Fig. 4), passes the coil inlet valve under a pressure of about 450 psi, see Table, to begin absorbing the tremendous heat released within furnace (about 1,000,000 Btu per cu ft).

Somewhere between 90-95% of the water coursing through the tubes becomes steam. The remainder does two important jobs. First, its rapid travel through the tubes scours the inside tube surface so scale or deposit buildup is discouraged. Next, it serves as a collector for any solids left behind by the water turned steam.

When this excess water together with the steam reaches the separator, sludge and scale can settle out and be blown down. Water separated from the steam in this chamber returns to the boiler cycle through a steam trap, a heat-exchanger coil, the economizer section, and then back to the main steam-generating tubes.

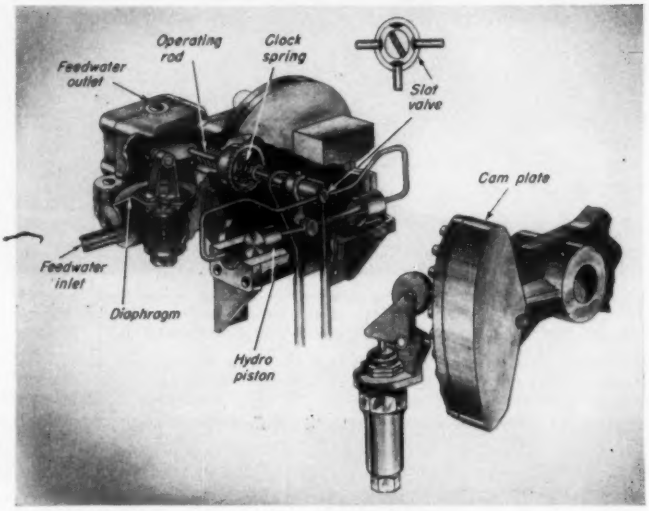
The economizer coil sets in the flue-gas exhaust chamber where it improves over-all efficiency by reclaiming some of the heat content in the exhaust gas. But it has an even greater preventive maintenance value. Here is the point where the incoming feedwater first approaches boiling temperatures. Internal oxygen leaves the water in this region, and whatever tube-pitting problems are likely to develop are confined to this section of the tube coil.

What's more, the corrosion problems, from dewpoint troubles with the leaving flue gas, hit in this same area. So this section of coil is separate from the main body and is easily reached for maintenance or replacement.

Main coils are staggered to split the flow of hot combustion gas leaving the furnace chamber in many thin paths so contact area between tube and gas is relatively large. Steam leaving the main coil outlet goes through a temperature limit control. This control cuts down the flow of fuel when steam pressure gets above the desired level.

Fuel Flow. Rate of fuel-oil supply is set so it will evaporate 90-95% of the water flowing through the coils. A hydraulically operated servo-control, Fig. 3, meters the No. 2 fuel oil to the burner

HYDRAULIC CONTROL METERS OIL FLOW TO BURNER



3 Diaphragm deflects in proportion to water flow and sets in motion hydro piston controls. They meter the quantity of No. 2 fuel oil reaching the burner head, Fig. 4, and also regulate the flow of combustion air reaching the fire pot, both in proportion to the feedwater entering the steaming coils of the boiler units

sprayhead, and regulates the quantity of combustion air reaching the fire pot in proportion to the water entering the coils.

The servo consists of a diaphragm chamber, Fig. 3, that receives incoming feedwater at its lower side. The water pushes the diaphragm up and passes through the opening between the diaphragm collar and the tapered metering valve. The height the diaphragm reaches depends on the rate of water flow through the diaphragm collar.

As the diaphragm goes up it turns the operating rod assembly against a clock spring tension and a retainer. This motion carries through the drive coupling assembly to the slot valve inside the shaft.

Oil from the hydraulic pressure feed line goes through the slot valve and ports in the shaft to the hydro pistons. These pistons, moving under hydraulic pressure, turn the shaft and revolve the cam plate. This same action moves the shaft ports away from the valve slots and shuts off the hydraulic pressure to the hydro pistons.

As the cam shaft and cam plate swing they regulate the position of the fuel-metering valve and the combustion air damper through roller linkage. The portion of oil supplying the hydraulic pressure to the servo drains back to the fuel-supply tank, top corner, Fig. 4.

Main stream of oil for combustion flows through the fuel-metering valve on the servo. A feed line takes it to a fuel strainer and then to the sprayhead. Here the fuel meets with compressed air and continues through an atomizing nozzle into the fire pot.

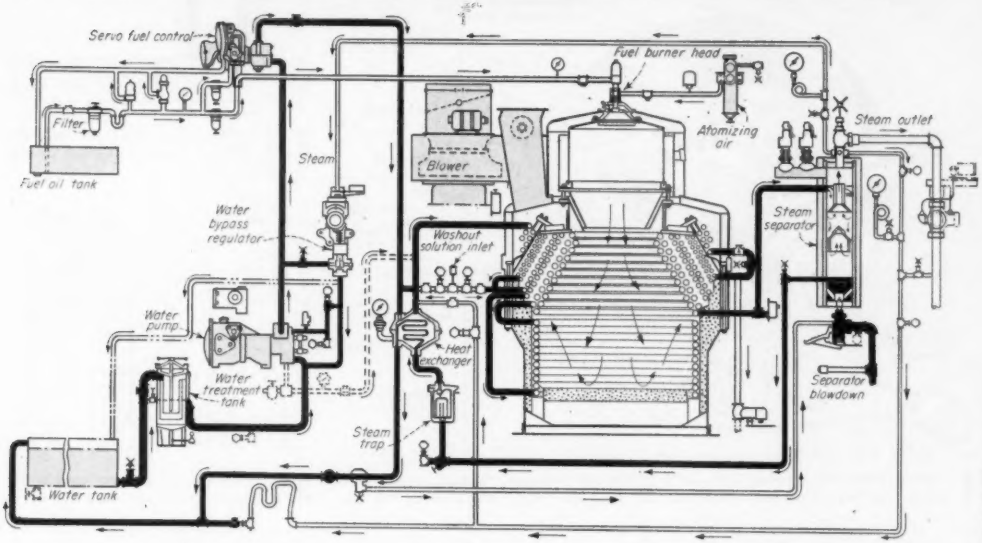
In the fire pot the fine oil spray mixes with air supplied by the blower and meets a continuous electric ignition spark. Hot gas from the resulting combustion flows over the steam-generating surface to the stack.

Maintenance. As Fig. 4 shows, there are many additional lines and connections tying into the principal boiler paths, just described. All are either safety or operating aids. For instance, the fuel-oil feed path has a bypass line to route oil back to storage if the low- or high-temperature limit switches go into action.

Similarly a special fitting, called a washout solution inlet, breaks into the boiler feedwater line so periodic flushing of the generating coils can be carried out easily. Reputable liquid inhibited-acid compounds serve as the washout solution.

When it comes time to lay up the boiler, the manufacturer recommends pumping the coils full of oil to prevent corrosion. Oil is fed through the water-

NOTICE HOW CLOSELY TIED CIRCULATION PATHS MAKE STEAMING UNIT COMPACT



4 Principal flow paths of fuel, water and air show in the sectional drawing above. In addition, many of the maintenance, operating and safety aids that have been built into equipment are indicated. Chief among these are the servo-fuel control, Fig. 3, the water bypass regulator, the fuel-oil bypass line, the water separator and blowdown. Of particular interest from maintenance standpoint is special washout solution circuit built in to clean steam coils with inhibited acid

treatment tank until it starts to come out the separator blowdown valve. This valve is closed and the control switch turned off.

Operation. The principal operating controls have been reduced to four: (1) servo-fuel control (2) water bypass regulator (3) stack switch (4) steam-temperature limit control. These last two are automatic protective devices.

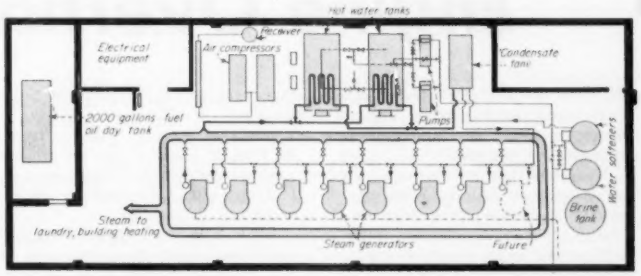
All valves have been given numbers. Those designated by odd numbers must be open during normal operation, while those with even numbers must be closed. The normally open valves have cross-type handles; the normally closed, standard round handles.

At the Ogden laundry of Union Pacific the battery of seven boilers, Fig 5, do more than supply the steam heating load. They act as the heat source for two 2000-gal instantaneous-hot-water heaters for 180-deg laundry water. In addition, the 100-psi steam from the boilers operates washers, ironers and presses.

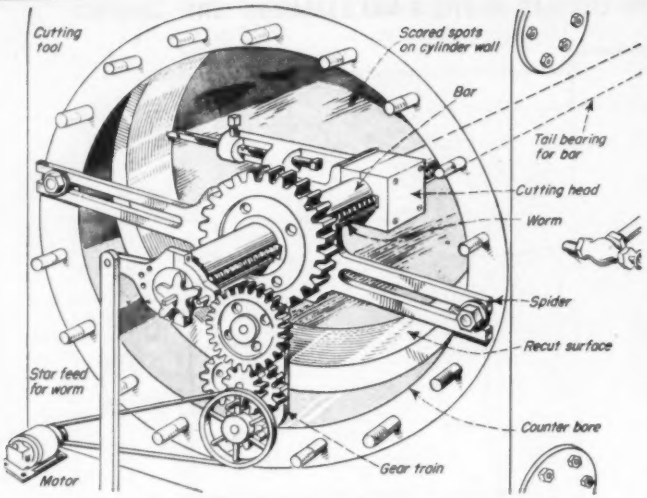
This laundry equipment includes eight washers, three extractors, four flatwork ironers, three dryers, 12 tumblers, 42 press units, six folders, one stacker, three tying machines, two continuous belt conveyors and a monorail system—the very latest in laundry aids in the way of material handling.

UNION PACIFIC STEAM-GENERATOR TEST RUN: COMING UP TO LOAD

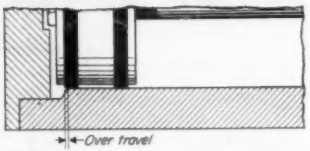
Water pumped, lb per hr	1570	3580	5520
Water return, lb per hr	260	400	610
Water evaporated, lb per hr	1280	3180	4910
Fuel pumped, lb per hr	924	882	889
Fuel return, lb per hr	812	630	504
Fuel consumed, lb per hr	112	252	385
Air pressure at nozzle, psi	70	70	70
Fuel pressure at nozzle, psi	20	56	97
Fuel pressure at manifold, psi	171	168	165
Water pressure, psi	170	300	420
Boiler pressure, psi	100	100	120
Steam temperature, deg F	340	348	361
Stack temperature, deg F	450	595	700
Percent CO_2	4	7½	11
Amperage—total boiler load	14	16½	19



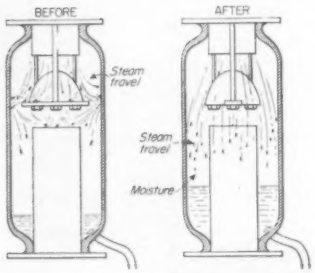
5 Floor plan of laundry shows battery of seven packaged boilers, water treatment system, two instantaneous hot-water heating tanks, compressed-air supply



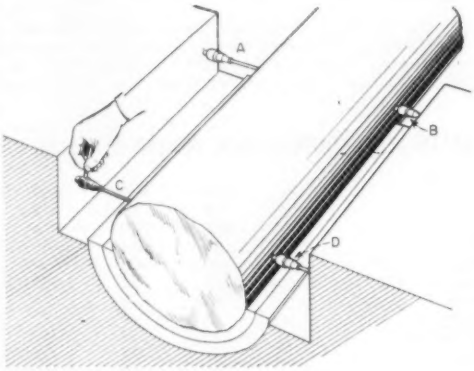
1 Here's setup for reboring horizontal or vertical cylinders. Lineup engine with piano wire first (Operator's Notebook 31, OE, July 1950), then set up the bar



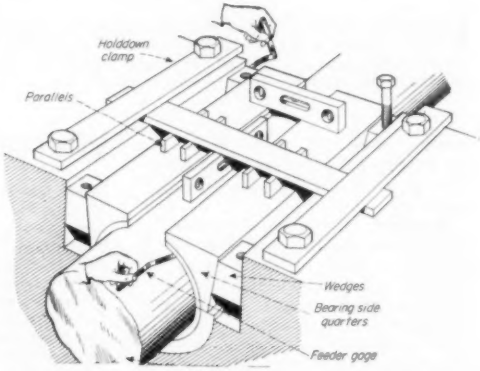
2 Piston ring traveling over into the counterbore prevents a ridge at end



3 Remove drip trough from cone baffle to help the separator do a better job



5 Check alignment of shaft with inside micrometer like this when fitting bottom half of newly scraped main bearings



6 Prussian-blue side quarters of main bearings and scrape-in to fit shaft. Check tapered wedge to see if uniform

Engine Overhaul Tips

► WITH OLD ENGINES straining to help keep production flowing for war emergency, now is the time to overhaul your reciprocating engines.

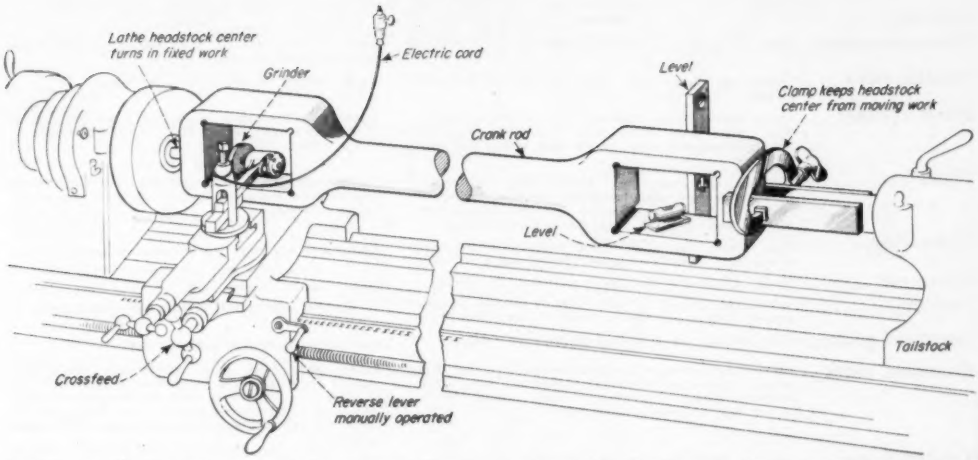
Wear and damage are main causes of steam-engine failure. Wear may be normal or it may be speeded up by erosive, corrosive or abrasive action of foreign matter in steam or lube oil, poor adjustment of moving parts, ill-fitting parts or damaged parts.

Damage may come from bad wear that weakens engine parts or throws them out of alignment. Priming by water from foaming boiler or from a high water level, is another common cause of damage. In many cases careless operation and unsound maintenance are direct causes.

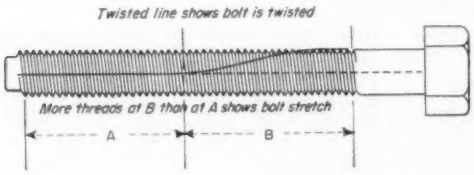
While a worn or partly damaged engine may run, it's always rarin' to give trouble. Wasted steam increases power costs, and wear continues until repairs MUST be made. It's best to overhaul engine completely. Major repairs usually insure efficient and troublefree operation for years.

Chances are you must do repairs in your plant. That means with hand tools, portable and makeshift equipment or such tools as you have. Remember, it pays to have it done by a specialized mechanic.

First Step. First inspect engine thoroughly. Examine each part for wear or damage and mark for re-use, repair

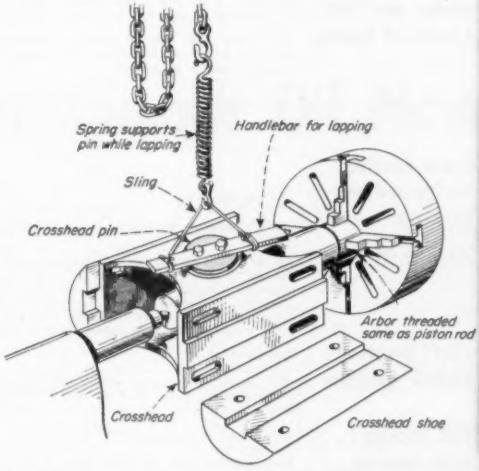


4 Setup for grinding horizontal surfaces of connecting rod. Lathe center revolves in stationary rod while compound rest feeds portable grinder over surfaces. Crossfeed clutch feeds grinder at desired speed. True up rod with levels as shown



7 Mark new wedge bolt with a straight line so it shows twist after it's in service. Twist causes threads to jam in the wedge. Line can be scratched across threads in lathe, milling machine or in shaper. Measure bolt for stretch by counting unused threads over distance *B* and compare with used threads in *A*, of same length. If stretched, renew bolt

Here are your gold nuggets. You don't have a corliss engine? So what? You can use this know-how for any reciprocating machinery. Author George Holman, Peoria, Ill., is a practical consulting engineer who knows repairs



8 Screw crosshead into rod, threaded same as piston rod. Spring helps support crosshead pin while lapping taper

or replacement. Order replacement parts, plan dismantling time to coincide with their arrival. Determine method of repairing worn or damaged parts in advance. You might have to re-machine new parts to fit. But guard against damaging a new part during assembly.

During inspection, examine engine parts in Trouble Shooters Guide (next page) for defects. Then make the indicated repairs or replacements.

If reboring engine's cylinder, tolerances must be close. Common practice for clearance between piston and cylinder is 0.001 in. per inch of piston diameter. The cylinder must be accurate to plus or minus 0.002 in. through its length. If you must rebore the engine counterbore, place parallels between the spider and the cylinder face.

Before putting piston into the rebored cylinder, oil walls and piston with cylinder oil. Compress rings with a strip of sheet metal clamped around the piston to hold down the outer edge of rings until inner edges enter cylinder. Lay strips of sheet metal across valve recesses to prevent ring ends springing out into them. Supply plenty of cylinder oil to cylinder for first hour or two. Shut down engine after running idle for a few hours and check up on all working parts before putting it under load. Then make adjustments.

More on next page

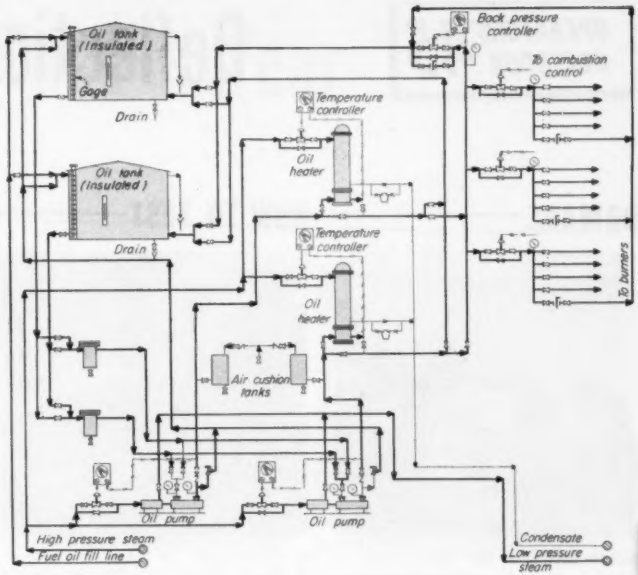
TROUBLE-SHOOTER'S GUIDE

Engine parts	*Defects*	*Repairs*
Steam separator	Sludge accumulation. Unsuitable baffle	Clean thoroughly. See Fig. 3 for cutting off water trough for better water separation
Throttle valve	Leaking seat. Scored stem. Galled stem threads. Hardened packing	Reseat. Rechase threads. Polish stem. Repack
Steam cylinder	Out of alignment with crosshead guides, or the crankshaft. Worn. Worn oval. Scored walls. Ridges at ring-travel end. Hard spots on walls, due to rings galling from poor lubrication	Rebore true to counterbore, to crosshead guides and to perfect 90 deg with correctly aligned shaft. If very bad, replace
Piston	Loose on rod. Loose nut. Scored. Worn on bottom. Galled spots from poor lubrication. Previous turning in cylinder to offset end clearance unbalance caused from wear or from setting up crank and crosshead bearings	Replace whole piston. Replace bull ring only. In emergency, build up with bronze and re-turn in lathe. Renew non-friction metal ring
Piston rings	Worn. Scored. Hard spots. Little tension. Fluffer caused by too much clearance in groove. End clearance too great	Replace with new rings after cleaning up grooves.
Piston rod	Scored. Corroded. Ridges and grooves worn by packing	Replace. Regrind. Remetal shaft.
Packing	Ridged and grooved on shaft contact surface. Sections warped. Sticking in annular grooves. Garterspring weak	Replace. Polish by lapping on arbor same size as piston rod
Crosshead guides	Worn. Scored. Out of alignment with cylinder shaft	Rebore. Polish out rough spots with stone
Crosshead shoes	Scored. Low percentage of rubbing surface in contact with guides. Wedged up to end of oblong lock screw holes. Drawscrew twisted or stretched to wedge distorted threads in nut, Fig. 7. Wedge surface uneven	Replace shoes. Smear guides with Prussian blue or paste made of lampblack in oil. Spot shoes on guides and dress off high spots until shoes have uniform contact surface. Turn crosshead on threaded arbor in lathe, threads same as piston rod, Fig. 8. Replace distorted wedge bolts marked as in Fig. 7
Crosshead pin	Worn on thrust sides. Scored. Misfit in crosshead bore. Wrong taper on wedging ends. Rough tapered surface caused by pin turning in crosshead bore under bearing seizure	Replace pin with new. Recut in lathe. Recut taper ends to fit crosshead bore, or rebore crosshead to smooth and proper taper fit. Turn pin 90 deg. Drawfile
Crosshead bearing wedge and bolt	Incorrect taper on wedge. Wedge thicker on one side than on other. Roughened wedge surface. Bolt threads galled. Bolt twisted or stretched to distort threads, Fig. 7	Replace wedge bolt. Recut wedge to proper taper for bearing fit. Smooth surface with file and emery cloth, or on lapping plate. Replace bolt
Crosshead bearing	Worn. Scored on internal surface. Small contact surface with pin. Rough on external surface. Rough wedge surface. Warped, cracked or broken	Replace. Rebore. Rebabbitt and rebore. Build up with bronze and rebore, also true any warpage caused by heat. Smooth with file or on lapping plate. Shim to make up for metal dressed off
Crank rod	Bent. Warped bearing eyes. Interior surfaces rough	Straighten rod. Be careful, this is a precision job. Level rod on horses, (eyes vertical) and dress interior surfaces to true, perfect and aligned rectangles. Cut eyes true on large milling machine. Cut eye ends true on small shaper. Grind horizontal surfaces true by set-up in lathe, Fig. 4. Job is semi-manual
Crank bearing, wedge and bolt	Same as crosshead	Same as crosshead
Crankpin	Scored. Worn on thrust side. Loose in crank disk	Recut. Replace. Drawfile and polish parallel to shaft line or level
Main shaft	Not at perfect 90-deg angle with cylinder crosshead guides. Bearing surfaces scored. Flywheel rotor of direct driven generator loose on shaft. Stator not true over rotor. Unequal flux gaps between poles and field windings. Pulley of belt-driven exciter out of alignment. Dressing accumulation, lacing or other belt fault carried to shaft. Shaft not level	Level shaft and align at perfect 90 deg with cylinder and crosshead guides. Regrind scored bearing surfaces, or drawfile and smooth with abrasive cloth. Tighten flywheel and rotor bolts. Set stator true over rotor and equalize flux gaps. Align exciter pulley. Repair, replace, or clean exciter belt
Shaft governor	Worn pins	Replace pins
Flyball governor	Worn joints. Valve stem worn. Valve piston rings worn. Valve cylinder worn. Packing hard. Packing rings lack tension	Replace governor mechanism and valve. Replace governor mechanism only. Polish stem of valve. Rebore cylinder of valve for oversize piston. Replace rings
Tail bearing	Worn. Scored. Too low	Replace. Scrape or rebore. Shim up pedestal
Main bearing	Bore of bottom half not level. Bore of bottom half not at perfect right angle to crosshead guides. Small percentage of bearing surface. Scored. Worn until shaft is too low. (If new bearings, shaft may be too high.) Contact surface scored. Oil grooves filled in or worn shallow. Wedge surface of side quarters rough	Replace bearing. Scrape or rebore until shaft aligns at proper level, with sufficient contact surface. Recut oil grooves. Lap or otherwise polish wedge surface of side quarters. Scrape bottom half to bear at middle, slightly low at each end. Check bottom half at blocks inside crankcase and as shown in Fig. 5. Fit side quarters as shown in Fig. 6. Defects and repairs of wedges and wedge bolts same as for crosshead bearing
Eccentrics	Scored surface. Scored or worn bearing surface in strap. Out of alignment with rocker-arm pin. Set at wrong angle ahead or behind crank. Too much or too little throw of adjustable throw eccentric	Smooth eccentric. Dress bearing surface of strap. Rebabbitt strap, and machine true in lathe. Strap may be tightened by removing shims. Set at proper angle with crank and align with rocker arm
Valve gear	Eccentrics set at wrong angle. Throw of variable throw eccentrics too much or too little. Eccentric rods too long or too short. Gear pins worn. Gear bearings worn. Bushings worn or scored. Gear bearing wedges not of proper taper. Levers not clamped tightly to stems. Levers at wrong position due to worn keys, keyways or to twisted valve stems. This data for non-releasing engine: Valve stems scored. Packing hard	Set adjustable eccentrics at proper angles with crank as measuring point. Adjust throw for full but not excessive rocker-arm movement. Adjust rods to equalize rocker travel. Replace pins. Replace bushings and bearings or rebore them to fit larger pins. Replace or recut wedges. Replace twisted stems. Fill worn stem keyways by welding, and recut ways. Caution: Omit use of off-set keys. Polish stems. Repack.
Engine valves	Wear. Scored valves. Scored seats. End play	Replace valves. Rebore seats. Take up end play at stem collars, or by placing small spring-loaded thrust collars or pistons at bottom of bearing
Exhaust stop valve	Leaking gate. Scored stem. Hardened packing. Galled threads	Replace gate and ring seats. Polish stem. Rechase threads. Repack

STEPS FOR TROUBLEFREE OIL FLOW TO BURNERS

1 Insulated storage tanks of the right size
2 Two fuel-oil pumps with close control over drivers
3 Twin strainers for each pump
4 Suction lines as short as possible from each pump to its storage tank
5 Automatically controlled fuel-oil temperature
6 Good fuel-oil circulation to outside heaters and back to storage to insure hot conditioned oil
7 Controlled viscosity by controlling oil temperature
8 Close pressure control of fuel oil to the oil-control valves
9 Ability to condition the fuel oil after delivery before using. (That is, time enough to allow good circulation and heating)
10 Proper instrumentation

MOST OPERATING PROBLEMS with fuel oils, old bunker C class, never crop up if you build sound practice, above, and right, into oil-storage and handling system



Latest Ways to Get Smooth Oil Flow

► GOOD BURNING of heavy industrial fuel oils, what we used to call bunker C, depends as much on the fuel-oil handling system as it does on the burner and the furnace. Here are down-to-earth tips to help get good fuel-oil handling.

Physical Layout. Locate the fuel-oil storage system to fit your supply and equip it with the right pumps, meters and valves. For instance, if you get your oil by barge you'd want a good-sized pump so you could unload in a hurry and save demurrage costs.

If you get it by tank car, have high-pressure steam connections close at hand and ready for use. With them you can heat up the oil in the tank car before you start to unload.

Trucks need space to move around in. So if you are going to get your oil by truck, see that you allow room.

Tank Size. Your plant needs pretty much decide the top size of tank you will put in. But size it to take advantage of maximum deliveries and also maximum probable time between deliveries. For instance, tanks for barge unloading will be very large.

Tank Equipment. Suction lines from storage tanks to fuel-oil pumps feeding burners should be as short as possible. The shorter, the better. If suction line has to be long, make the pipe larger in size to compensate for the long run. Insulate tank to reduce heat losses.

Vent the tank to the atmosphere. But do it in a way that no rain can get into the tank. Make sure while you're about it that no unwanted material, like newspaper, dirt, water, can get in.

Put a manhead near the bottom of the storage tank so you can clean the tank manually if you have to.

Make an overflow connection to a sewer or other safe container or pit, so you can't flood the top manhead or vent and spill oil over the tank sides.

Pipe in a water drawoff or drain.

Equip each tank with an indicating angle-type thermometer so you can check oil temperature within the tank.

You can save the cost of heating coils in storage tanks if you circulate enough stored oil through external heaters and return it to the tank. In fact, with enough circulation and proper strainers chances are you'll never have to clean your tank out by hand.

Supply twin strainers in each suction line to fuel-oil pumps. By proper valving you can clean one strainer while the other is handling the regular flow.

Shooting Trouble. Two similar-sized fuel-oil storage tanks give your system flexibility. With two you can always supply oil even with one tank out for cleaning or repairs. What's more, you have time to condition incoming fuel oil after delivery and before burning. By "conditioning" we mean circulating it and raising its temperature outside the storage tank.

Where you have steam coils inside the storage tank for heating, make sure they are all-welded coils. Any leaks—and you'll have the condensate mixing directly with the stored oil.

Some fuel-oil systems use suction heaters in the suction line to the fuel-oil pump. Once again, be sure they are all-welded coils. Any leaks in a suction heater give you water troubles.

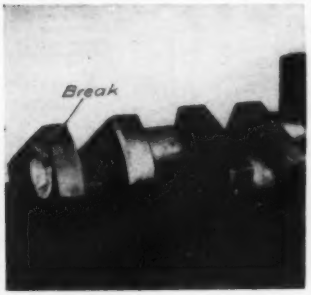
It's doubly important to have a recording temperature instrument on steam-coil heated storage tanks, plus careful temperature control. You want to be certain tank temperature never gets above the boiling temperature of water because any coil leaks could cause the storage tank to boil over.

O F CAMPBELL, *Combustion Engineer*
Sinclair Refining Company

OPERATORS' NOTEBOOK 45

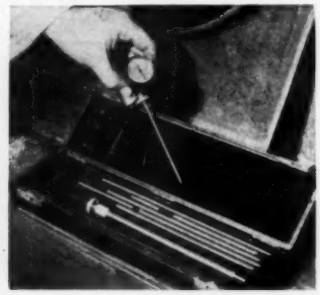
Deflection-Test Your

DAMAGE

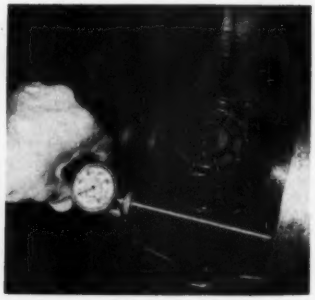


SHAFT BROKE at web from fatigue as a high bearing bent shaft with each rev.

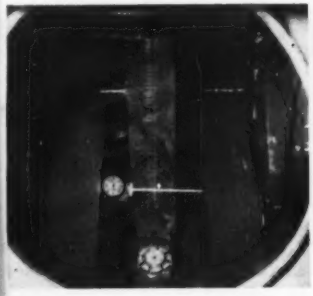
HOW TO TEST



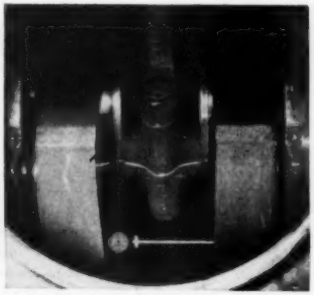
1 Strain gage set measures misalignment without taking crankshaft out



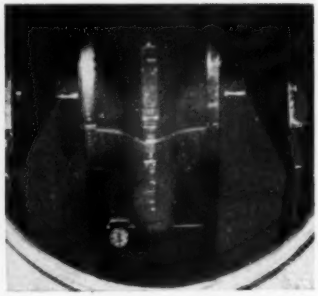
2 Place gage between webs. Spring tension against points holds it in place



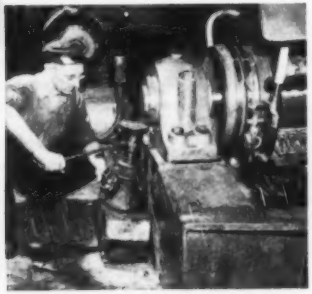
6 Set dial to zero. This gage balances itself so face is always to operator



7 Jack the crank to quarter position. Needle hasn't moved from zero mark

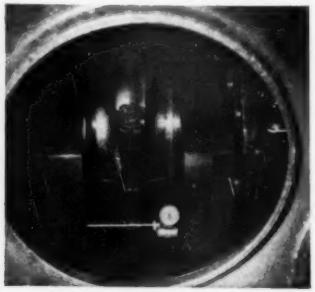


8 Jack to top, then quarter position. Needle stays on zero; this crank's OK



12 Lift assembly a few thousandths by screwjack, enough to remove shim

13 Remove 0.015-in. shim. Then take away jack and tighten down bolts



14 Now gage readings in four spots on generator-end webs read zero

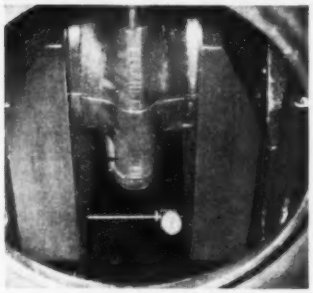
Crankshaft Once a Year

By STEVE ELONKA, *Associate Editor*

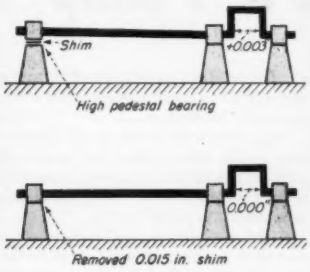
3 Spin balanced gage around a few times after setting the dial to zero

4 0.003 in. reading shows that points have imbedded into metal this much

5 Jack the crank over so that it is near the bottom dead-center position

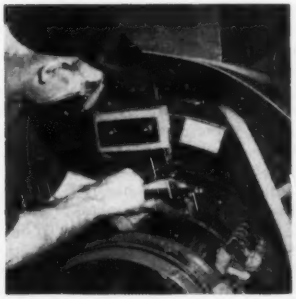


9 Gage on generator end crank shows top dc out 0.003 in. from bottom dc



10 High pedestal bearing is answer. Removing 0.015 in. should correct

11 This pedestal bearing wore less than crank bearing. Loosen nuts



15 Check air gap all around on generator with feelers. Adjust if uneven

HOOK'S FORMULA

$$\text{Stress} = \frac{43{,}500 \times d \times t}{L^3}$$

43,500 = a constant
d = distortion in mills (not a decimal)
t = crankweb thickness, inches
L = ½ engine stroke in inches

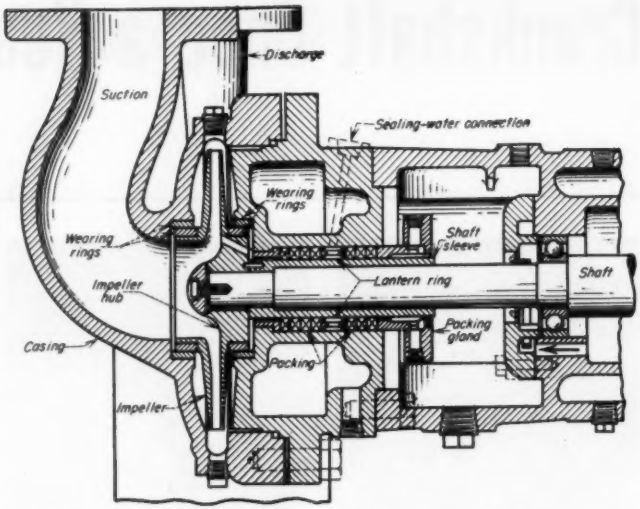
If greatest difference between any two readings is 0.003, the web thickness 3 in., and stroke 14 in. we get: (43,500×3×3÷ (7×7) = 7989 psi. The answer is strain in psi on webs.

16 Calculate stress on webs from distortion to see if limit is exceeded

17 If stress exceeds 20,000 psi, whitewash test to find cracks like this

A centrifugal pump may be a sweet-running cooky or a pain in the neck, depending on the kinds of metal from which it is made. You want the sweet-running one so here is how you can get it

BY J J COFFEY,
Engineer
Pacific Pumps, Inc



1 Casings of centrifugal pumps are often made of cast iron with different alloys used where a better material is needed for the particular liquid to be handled

Do You Know Pump Metals and

► MATERIALS for centrifugal pumps include bronze, stainless steel, lead, cast iron, rubber, glass, enamel and stoneware. With proper materials and construction, these pumps successfully handle water, acids, heavy oils, chemical solutions, and even molten lead.

Here we will consider the materials generally used for the casings, impellers, wearing rings, shafts, shaft sleeves and packing glands. The liquid pumped does not usually affect bearings, bearing housings and other outside parts.

Pump-Casing Materials. Casings are often made of cast iron, with different iron alloys selected when a better material is required. As liquid pressure and temperature go beyond limits for which cast iron or its alloys are suitable, cast steel and then forged steel are used.

If the liquid is corrosive or otherwise chemically active, stainless steels of 5 to 6% chrome, 11 to 13% chrome, or 18% chrome and 8% nickel can be used to advantage. Bronze casings are often used for sea water or similar slightly corrosive liquids.

Pressure and temperature, or the kind of liquid pumped, are not always factors in selecting proper material for pump casings. Most oil refineries specify against cast-iron casings for any process pumps, regardless of service conditions. This is because these units are subject to rough handling that often damages the casings.

Also, cast-iron pump nozzle flanges may crack when bolted to flanges of suction and discharge piping, normally steel. Flanges may be broken by piping strains on the pump nozzles.

Another reason that oil refineries use cast steel is that a fire may occur in the pumphouse and the pumps get sprayed with water from a hose or sprinkler system. If this happens, cast-steel casings of hot-oil pumps will stand the sudden temperature drop and thermal stresses better than cast iron.

Cast Steel. This also applies when a maintenance man washes a cold-service pump and accidentally splashes water on a nearby hot one. When cast-steel casings are damaged they can be repaired by welding where cast-iron casings must be replaced.

Cast-steel casing pumps can also be used in a greater number of services, for instance with higher temperatures and pressures, than can cast-iron casings. This is important in refineries and similar industries where a process may be changed. Then existing pumps may have to operate under different conditions than those for which they were purchased.

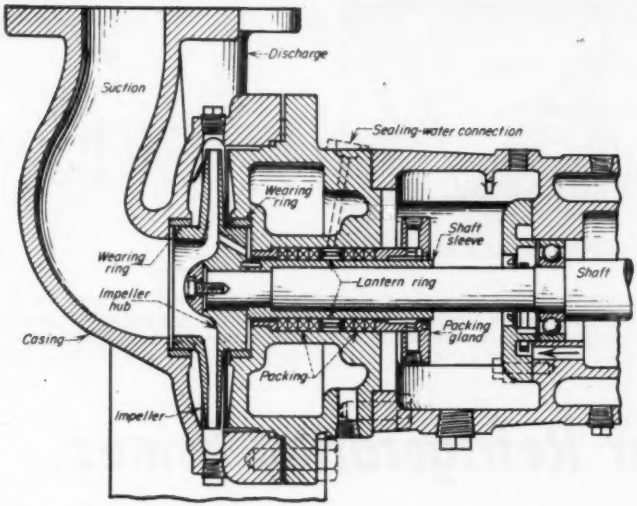
Impeller Material. For machining, casting and resistance to rusting, bronze is an ideal material for pump impellers. But for a given temperature change, bronze impellers expand more than the steel shaft on which they are mounted. In addition, centrifugal force stretches the rotating impeller hub.

Because of these forces, radial clearance between pump-shaft and impeller hub may let pumped liquid leak between the hub and shaft, and erode the latter. For this and other reasons, cast-iron, cast-steel or stainless-steel impellers are often used instead of bronze when liquid temperatures exceed 250 F and speed is high.

Pumping Electrolytes. When the liquid is an electrolyte, do not use one kind of metal for the casing and another for the impeller, such as a cast-iron casing with a bronze impeller. Galvanic action between the two metals may cause serious corrosion.

Use cast-iron, cast-steel or stainless-steel impellers with cast-iron casings; bronze impellers with bronze casings.

Structural details of the impeller must be considered when selecting material for a pump. For instance, if the service requires an impeller of large diameter or thin walls, maybe cast iron does not have the strength even if it meets



2 Many pumps have wearing rings on the impeller and in their casing, Fig. 1, while others have a single wearing ring in their casing without one on impeller

Why Each Is Used?

MATERIALS USED FOR CENTRIFUGAL-PUMP PARTS

Pump parts	Water to 250 F	Noncorrosive oils to 350 F	Corrosive oils 350 to 850 F
Casings	Cast iron	Cast steel	11-13% chrome steel
Impellers	Bronze	Chrome-nickel iron	11-13% chrome steel
Wearing Rings	Bronze	Chrome-nickel iron	11-13% chrome steel
Shafts	Carbon steel	Carbon steel	SAE 6140 stainless
Shaft sleeves	Bronze	Case-hardened steel	Stellite on 18-8

the corrosion and erosion requirements.

Wearing-Ring Material. Many pumps have impeller and casing wearing rings, Fig. 1. Other pumps have a single-casing wearing ring only, Fig. 2. To prevent galling or seizing, one wearing ring must be at least a difference of 50 Brinell numbers harder than the other. Bronze may be used as the wearing-ring material for a great number of services, but not where high resistance to abrasion is needed.

Cast-iron, cast-steel and stainless-steel wearing rings have many applications. The last two are favored where hardness is a factor. Any of these materials may be used regardless of the impeller, but avoid unlike metals in electrolytic solutions.

Impeller Shafts. Pump shafts that have sleeves, Fig. 1 and 2, to protect them against the pumped liquid and packing wear are often made of open-hearth forged steel. Where sleeves are not used, shafts are often stainless-steel, monel or phosphor bronze, depending on the liquids handled. Sometimes pump power and speed may require the higher tensile-strength steels.

Shaft Sleeves. To seal against leakage, stuffing-box packing presses against the shaft sleeve. So, make these sleeves only of materials that can be finished to a smooth surface. For most water services except boiler feed, bronze is a suitable material. But where even slightly abrasive liquids are handled, bronze does not work well so use hardened-steel or stainless-steel sleeves.

When mechanical seals are used instead of packing, the seal's rotating element is usually fixed to the shaft sleeve by a setscrew. For the setscrew to get a good bite in the sleeve, mild steel is a good material.

Packing Glands. Bronze is more commonly used than any other metals for packing glands, with cast iron, cast steel and stainless steel used in all-iron pumps. Where sparks might ignite vapors from the liquid handled by centrifugal pumps, cast-iron or steel glands must be bronze bushed. Monel is also used for packing glands because of its sparkproof quality.

The table gives examples of materials used for centrifugal-pump parts, indicated in Fig. 1 and 2, for different services. Column 2 from the left shows materials normally used for pumps handling water up to a temperature of 250 F. Materials in pumps handling noncorrosive oil at temperatures up to 350 F are given in column 3. For pumping corrosive oils at temperatures from 350 to 850 F, materials in column 4 can be used. Where cast iron, bronze and steel serve for water up to 250 F, hot-corrosive oil requires chrome and stainless steels to meet the severe operating conditions successfully.

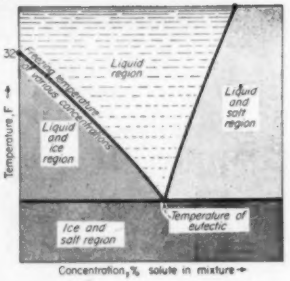
For a given application, centrifugal pumps might be classed as no better than the materials used in their parts in contact with the pumped liquid. They are made of almost all known common metals and metal alloys, as well as many other materials to meet practically any operating condition. Service conditions and nature of the fluid to be pumped determine to a large degree the kind of material. When in doubt, consult the manufacturer. He will gladly give you the benefit of his experience.

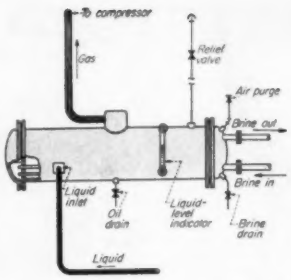
LEAK-PLUGGING HINTS

To stop a steam or liquid leak when a drain line is broken off or a plug blows out, drive a tapered plug of soft pine. Wooden plug stops steam or liquid because it swells on inside, holds tightly. Boiler tubes have been stopped with wooden plugs in shipboard emergencies.

To stop tiny leaks in a steam condenser without taking it out of service, sift fine sawdust. Slow down circulator and pump sawdust through condenser. Vacuum on steamside will draw fine particles into the small holes. If salt water is used for cooling, check condensate salinity every 15 minutes. If salinity indicates further leaks, pump more sawdust.

Don Kelland, of New York City, quickly reviews brine properties important in refrigerating - plant operation. You will find this article handy for a quick refresher of brine types, uses, pipes, and treatment. Read it and see how easy it is to . . .





BRINE SOLUTIONS follow general curve, *left*, when temperature decreases. Salt solution with lowest freezing point is called a eutectic mixture, freezes at the eutectic temperature. Solutions of other concentrations freeze at higher temperature, deposit pure ice or salt. Shell-and-tube brine cooler, *right*, has many uses

Know Your Refrigeration Brines

► BRINE TRANSFERS HEAT from cold rooms or coils in your plant to the refrigerant liquid. It's easy to pump, doesn't require expensive pipe and can be simply and quickly prepared. Being an important heat-transfer medium, brine deserves good care at all times.

Brine Types. Choice of type depends on operating conditions and other factors. In this article we'll stick to chloride brines—sodium, magnesium and calcium chlorides. Certain of these find much use in plants serving various types of loads.

Calcium-chloride ($CaCl_2$) brine is used more frequently than sodium chloride (NaCl) because it has a lower freezing point (—59.8F vs —6F for one concentration) and is less corrosive. NaCl is used for ice making and other jobs where brine leakage might spoil the product. Magnesium chloride ($MgCl_2$) is unstable when concentration is high and temperature low. It is not generally used in large-capacity systems.

Brine freezing point depends on the strength of the solution or how much salt is dissolved in the water; see curve above. Higher concentrations mean lower freezing points, up to a eutectic mixture; weak solutions freeze at relatively high temperatures. Specific heat decreases with increase in concentration.

Application. Now let's look at effects various properties have on brine uses. Concentration is important because too great strength may cause plugging of pipes when salt crystallizes from the solution. Weak brines may freeze on the expansion coil, cut down heat transfer. Under these conditions crystals of pure water freeze out first. Some practice specifies brine with a freezing point 10 F or more below lowest temperature expected in system operation. Then there is little chance of freezing or crystallization.

For good results in small plants where close watch can't be kept on brine concentration, keep solution as strong as possible without causing instability. As a general guide in usual plants, specific gravity of NaCl brine should be less than 1.17, and $CaCl_2$ below 1.29. Inspect refrigerant coils in brine tank or cooler regularly to see that ice hasn't formed. If it has, brine concentration must be changed.

Brine Piping. Steel, wrought-iron or cast-iron pipe can be used in brine systems, depending on service. Corrosion isn't a serious problem in brine piping if proper precautions are taken to prevent brine from becoming too acid or alkaline. Seamless pipe is generally used for steel pipelines.

For small plants where system head is low, the 2-pipe system is suitable for circulating brine. One pipe feeds brine to coils and the other returns it to the cooler. For large jobs, especially those in tall buildings, the 3-pipe system is generally used. In this, brine flows upward and into branches at each floor. Returns, from units served, discharge into a riser that ties into a balance tank on building roof. From this tank brine returns to cooler. Fit all brine piping with vents at points where air may accumulate.

Treatment. Corrosion prevention is an important job in brine systems. You can't prevent corrosion entirely, but you can slow it down to a rate that does little harm. Good practices will save you plenty over a period of years.

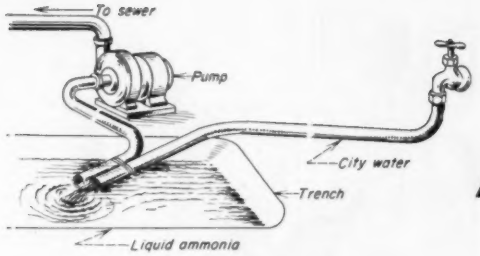
Test brine every week. It should be neutral or slightly alkaline, with a pH range between 7.2 and 8.5. Sodium dichromate is an effective treatment for both NaCl and $CaCl_2$ brines. Usual treatment uses 125 lb of sodium dichromate dissolved in warm water for 1000 cu ft of $CaCl_2$ brine and 200 lb for equal volume of NaCl brine.

Remember that sodium dichromate causes brine to become acidic, and soda or lime may have to be added for neutralization. Add dichromate in four steps, using equal quantity each time and neutralizing after each addition. About 35 lb of 76% flake caustic soda may be needed for 100 lb of chromate.

Test brine with universal indicator solution to determine acidity and alkalinity. Color changes from red to violet as pH varies between 4.0 or less, acid; and 10 or more, alkaline.

Brine Quantity. When putting in a new system or making additions to an existing one you must know quantity of brine to be circulated before you can choose pipe sizes and circulating pump capacity. Use POWER's Data Sheet No. 215 which appeared in May '50, or standard equations in various handbooks. Usual practice limits brine temperature rise to 5 F or less, with a velocity in pipe of 5 to 7 fps. Under these conditions 5 to 6 gpm per ton of refrigeration must be circulated.

Pump capacity is chosen on basis of required brine quantity and head needed to carry system load. Use all-bronze pump fittings for mixed and NaCl brines and all-iron for $CaCl_2$ if pH is 8.5, otherwise all-bronze.



2500 lb of liquid removed in emergency and no damage done from . . .

Ammonia Spill

By H C WELCH, *Retired General Manager, American Ice Co.*

► I ONCE HANDLED an ammonia spill in a large plate ice-making system. The liquid-ammonia line broke off in a pipe tunnel and over 2500 lb of ammonia ran into a concrete trench.

We had the tunnel clear in about three hours so it was safe enough to go in and make repairs. There were houses directly across the street from the plant. But no one in the neighborhood was aware that anything unusual was taking place.

Removing Ammonia. We ran two one-inch hose lines into the trench and tied the ends together. Then one line was connected to the water supply and the other to the suction end of a pump.

Because water absorbs great volumes of ammonia gas, the diluted ammonia became gradually weaker as the pump removed it. This method is the simplest and easiest way to remove liquid ammonia from any low and inaccessible place.

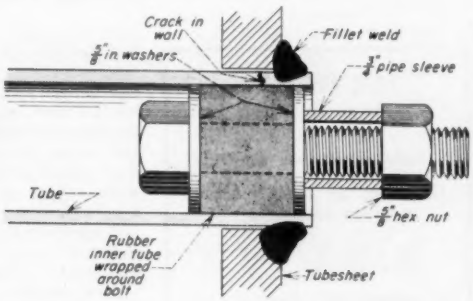
All class A and B systems in large metropolitan areas have ammonia mixers connected to the city sewer. These mixers (see page 106, March 1950, POWER) are connected to the refrigerating system's high and low sides. Also to the city-water supply. They discharge ammonia into the sewers in serious accidents or fires. With a standard mixer, having a 2-in. water connection, it's possible to discharge 20,000 lb of ammonia into the sewer in a matter of minutes, without danger to the public. If your plant does not have one, you had better install a mixer.

The greatest hazards, in my opinion, for bad ammonia leaks, are open lights or arcs from disconnecting switches.

Condenser Repair

Why tubes crack, and how to repair quickly

By M W SHAFFER, *Philadelphia, Pa.*



► WE HAVE A BANK of 7-tube multipass ammonia condensers, of all-welded construction. There are six stands, ten shells high, 18 ft long, with a total of 420 two-inch, 9-gage tubes. These were put in service in 1928. Beginning in 1944, we replaced ten tubes. There were no failures from corrosion. But there were circumferential cracks in the tube-walls, about ½ in. from the end, at the base of the weld.

These condensers take the discharge from six double-acting ammonia compressors. Under conditions of high pressure and pulsations of compressor's discharge, tubes are set in vibration. I believe this contributes to their failure.

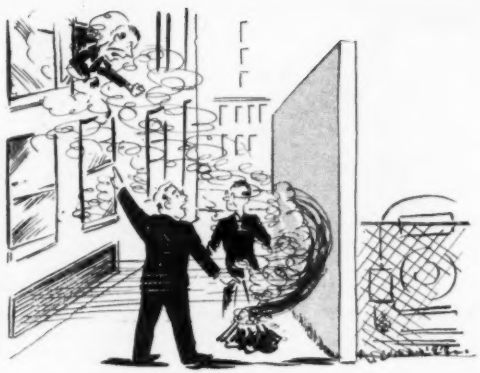
Failure. Condensers have seven tubes in an 8-in. pipe shell, symmetrically arranged, in circle. The tubes have no support for the 18 ft length, other than tube sheets at ends. Holes in tube sheets are about ⅛ in. larger in diameter than the tubes. Tube ends project ⅜ in. through tube sheet. A fillet electric weld fastens and seals each tube in the shell.

I believe tubes failed because they were not expanded into tube sheets before they were welded. Therefore, thin weld fillet around unrolled tube takes all vibration until weld breaks from fatigue.

As yet we haven't any records to prove our reasoning. But we expand all new tubes into tube sheets before they are welded.

When one of these tubes fail, we have to take ten shells out of service to replace the one tube. That's our biggest headache. This is not always convenient so we made up a plug, shown in sketch. This seals off the leaking tube temporarily. Plug is made of a ⅝x4-in. machine bolt and two ⅝-in. wrought-iron washers filed down to fit snugly in the tube. A piece of old inner tube is cut into a strip about 1¼ in. wide, long enough when wrapped around the bolt several times to fill up the space between the washers. A short piece of ¾-in. pipe serves to bring the nut out where it's easily turned. When the nut is tightened on the bolt, the rubber expands against the tube wall. This seals off the leaking tube until we can make a permanent repair.

SUMMER HEAT brought plenty squawks. .



BONFIRE showed discharged-air travel. . .

TROUBLE SHOOTING

"I won't pay another cent on this air-conditioning system until it works," squawked the building owner. That's when C T Baker, consulting engineer, Atlanta, was called in

HERE ARE THE 14 BONERS HE FOUND

1 Toilets vented into hall—Phew!

2 Discharge air pulled back into the building—not good!

3 Wet intake air ruined plastered ceiling—expensive!

4 Compressor-oil equalizing line didn't work as intended

5 No line strainers

6 No Freon dryers

7 No pressure gages

8 Electrical switches and fuses were too small—not safe!

9 No liquid receiver

10 Cooling-water tank uninsulated

11 Chilled-water lines uninsulated

12 No control for outside air

13 No shutoff on liquid tank

14 No air circulation between the offices

► I GOT AN SOS 18 months after an air-conditioning contract had been signed. The plant was placed in service, but they couldn't maintain right conditions. With heating season started and winter air conditioning needed, more trouble developed. Finally, the owner refused payments. That's when I was called.

Contractor agreed to furnish and install year-round air conditioning. He promised an inside dry bulb of 80 F, a relative humidity of 51% during summer months, with outside dry bulb of 95 F and wet bulb of 78 F.

Winter conditions were: outside dry bulb, 10 F; inside, 72 F dry bulb and 35% relative humidity.

Plant had three Freon-12 compressors, each driven by a 50-hp motor; an evaporative condenser; atmospheric cooling coils; an air-cooling unit in a room on each floor.

Compressors and fan, handling air and water vapors through and from evaporative condenser, were in basement just beyond building wall.

Wet Air. On first floor, window near floor is open in summer. So high-velocity moist air discharged from fan struck opposite wall and was pulled back into window. I proved this by releasing smoke against parking-lot wall.

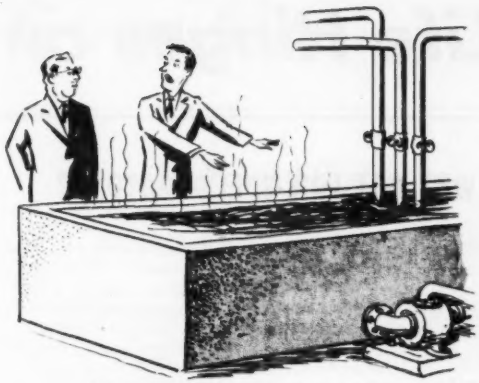
Then again water vapor entering window did plenty damage to ceiling plaster. It was worse when wind velocity and direction changed. We fixed that by extending discharge duct above and beyond parking-lot wall. Now heated air and water vapors discharge far enough from window and don't enter building.

Another fault of original design was heated air and water vapors being pulled back into condenser with fresh air. So mixture's high relative humidity reduced condenser capacity. Relocating fan discharge duct corrected this, also.

Oil-Level Troubles. Compressors were in line, on 8-ft centers. For uniform crankcase oil level in machines, an oil-equalizing line was connected to the three crankcases at bottom. A similar gas-equalizing line was placed at top.

This worked only on paper. With machines running, oil level in one machine always dropped to danger point. Level in other two crankcases would rise. Finally, the crankcase oil level varied so widely in machines that someone always had to stand by.

Checking fault I found gas- and oil-equalizing lines only $\frac{3}{8}$-in. diameter. So pressure loss, due to friction, was enough to prevent equal oil levels. I solved this by changing to a 2-in. oil-equalizing line at the bottom, with a 2-in. connection between each crankcase and the main. I also changed the gas-equalizing line to 2 in. After this,



NO INSULATION heated cooling water. .

WINTER COLD caused scenes like this

all three machines held uniform oil levels.

Small equalizing lines have burned up many bearings where two or more compressors were run in parallel.

This plant had other machinery troubles. For example: no strainers on suction inlet to keep pipe scale, grit, etc, out of compressors. This omission was especially serious because pipe coil evaporators and suction lines were not copper. As Freon-12 is an efficient cleansing agent, it soon loosened mill scale and dirt in system and carried it into compressors. That harmed them plenty.

No Pressure Gages. With three Freon compressors, totaling 150 tons, this plant had no Freon pressure gages. "We never leave pressure gages in place when we're through testing our equipment," explained the contractor. "If the operator wants to know the pressures, we send a service man to check them." Of course, the owner had to pay for service man's time.

All air-conditioning and refrigerating plants, regardless of size or refrigerant used, should have gages to show pressures *above* and *below* atmosphere.

No Freon Dryers. Moisture in Freon-12 systems must be removed. Dryers do the trick. Dryers should have a bypass, valved for replacing drying material without shutting down the plant. Bypass also allows changing drying agent without admitting moist air into system. This plant had no dryers.

Motor Switches. Full-load running current of the 50-hp-compressor motors was given as 142 amp. But the locked, or stalled, rotor current was named by the motor's builders as 568 amp.

I found a 30-hp switch, fused for 200 amp, instead of a 50-hp switch with 400-amp fuses, as specified by National Board of Fire Underwriters.

I added larger switches, along with pressure gages and Freon dryers to improve and solve compressor headaches.

No Liquid Receiver. There was no liquid receiver between condenser and evaporator in this 150-ton plant. So there was incomplete and interrupted drainage of evaporative condenser coils. Condensing pressures were also away above normal.

I solved this by installing an ASME Code receiver with ASRE Code dual safety valves and gage glass. Also a full-size 1¼-in. drain line between condenser and receiver.

Watercooling Coils. There were coils for cooling water for air-conditioning units on various floors. Coils were placed in a rectangular concrete tank, 34 ft long x 12 ft wide x 32 in. deep. Tank rested directly on the 3-in.-thick concrete floor.

There was no insulation on tank's bottom or sides, also no top cover. Since machine room usually was from 90 to 95 F and above, it's easy to see that 45-F water would re-absorb much heat in uninsulated tank.

I replaced it with an insulated horizontal shell-and-tube multipass water chiller of 150-ton capacity. This was based on cooling 450 gpm through a range of 8 F, or from 48 to 40 F.

My figures showed heat leakage into the concrete tank, including uninsulated sides, bottom and uncovered top, equalled 2½ tons of refrigeration.

Bare Pipe Loss. The 3- and 4-inch chilled-water mains from basement to ninth floor had no insulation. So heat loss to the cold water was excessive. The insulation had been delivered, but it was left stored for two years. That didn't help the power bill.

One for the Book. Two second-floor toilets were supplied with cooled air in summer and heated air in winter, which was OK. Return air from each toilet passed through a return grill in the door's lower panel, then into return-air stream, traveling through corridor and back to air cooling unit. So what? They had bad odors in most sections of that floor. A 16-in. exhaust fan in each toilet stopped that. Each unit handled 1400-cfm air, enough to fully ventilate the rooms.

Outside Air Cheap? Individual air coolers on each floor were 12 ft square, with about 13 ft clearance from floor to ceiling. In one wall of each room was a frame of 36 x 32 in., fitted with eight louvers. Only thing wrong with this wall fresh-air opening was there was no way to control outside-air flow into air-cooling system. This caused a great refrigeration loss because much more outside air entered building through louvered opening than was needed. During heating season, this large volume of cold outside air shot the fuel bill way up. I put in automatic damper control.

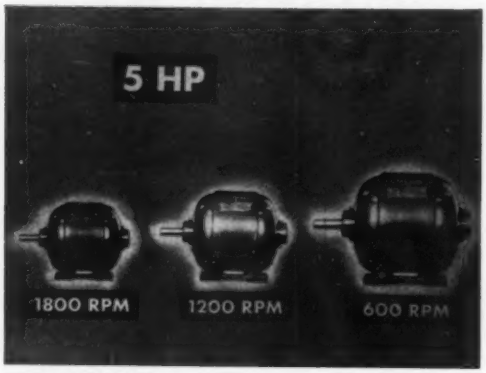
More Corrections. Besides major faults, here's lesser ones corrected:

Return grilles installed in lower panels of doors connecting various offices with corridors. Before, door between office and corridor had to be left open so air reached corridor and returned to air-conditioning unit.

Dampers installed on all floors in supply ducts to each room to help balance air-distribution system.

Installed shutoff valves on three section outlets of liquid tank connecting water-chilling coils. Only valve on suction line between water-chilling coils and compressor, was the stop-valve at suction inlet of each. If this valve leaked when compressors were opened for inspection, much refrigerant would be lost. These changes did the trick.

Gearmotor Life Hinges on



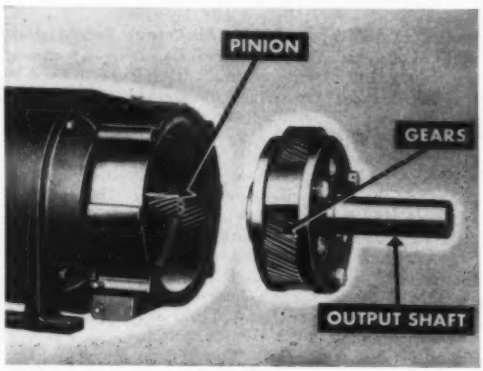
LOW-SPEED MOTORS look like a natural for direct-connection to load. But size, cost, efficiency often favor gearmotors

WHY NOT LOW-SPEED MOTORS?

Efficient speed for most electric motors is 1800 rpm. Yet most machines operate below this speed. To use these machines one of two things can be done; provide a high-speed motor with a mechanical power-transmission unit to drop speed or use a low-speed direct-connected motor.

But there are several drawbacks in using a low-speed direct-connected motor. First off, a 5-hp, 1200-rpm motor is almost 50% larger than an 1800-rpm job. And at 600 rpm the motor is over twice the size of an 1800-rpm unit.

There are other problems too. Using a low-speed motor generally means low power factor and efficiency. This all adds up to higher power costs. Naturally there are jobs where low-speed motors are well suited. Typical would be in the 1200- to 900-rpm range if size and weight drawbacks are not serious. Between 700 and 900 rpm most fellows use belts and an 1800-rpm motor. But from around 780 rpm down, use chain drive, belt drive, gear reducer or gearmotor.



GEARMOTOR has its pinioned motor shaft connected to output shaft through gearing. Motor and gears are all in one unit

HOW GEARMOTORS WORK

Gearmotor unit uses a standard 1800-rpm ac or dc motor. It has a gear housing and an adapter that replaces one end-shield. Adapter connects motor and gear housing. Motor shaft-pinion drives a gear or series of gears linked with the output shaft. Result is a compact unit that's actually smaller than a similar low-speed standard motor of same hp.

For very low speeds use gearmotors plus chain drives. Gearmotors are easy to install and maintain since all parts are on a single base. Actually, gearmotors can be used to drive a variety of loads ranging from a simple conveyor to a heavy-duty cement kiln.

There are two major steps in selecting any gearmotor. First select motor and then the gear. You'll find the highlights of motor selection outlined below. Over on the gear side of the fence there are but three classs of gearmotors. Each has a different size gear (load-carrying ability) for different load conditions. Don't buy a gear too big, or worse, too small

MOTOR SELECTION starts with study of driven machine

In brief there are five basic steps to be followed in selecting the motor: (1) Study characteristics of driven machine —torque requirements, speed, load swings, etc (2) Find motor hp (3) Know voltage, number of phases, frequency of your supply (4) Plan control equipment (5) Select proper motor enclosure. Consider surrounding conditions such as water, dust, gases, etc.

This sounds like a big order. But you can cut it down by glancing back to pp 108-111 in POWER HANDBOOK, July '51 issue. There you'll find four pages covering the high points in selecting the more commonly used motors.

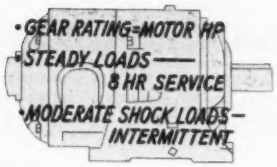
Of course you can get load and speed requirements of the driven machine from the machine manufacturer. In many cases the machinery people will have prepared tables that show the hp required for their machines. Another short-cut is the "experience" formulas usually listed by machine manufacturers. Typical would be a fan manufacturers handbook showing how to find the hp required for any set of conditions. All popular enclosures are available for gearmotors suitable for vertical and horizontal drives.

Gear Size

And here's how to get the right size gear. All info by General Electric Co

ALL GEARS FIT INTO one of 3 basic classes

CLASS I

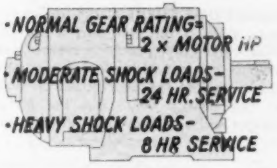


STEADY LOADS, not above motor rating, 8-hr day basis call for Class I units. Almost half all jobs fall into Class I

CLASS II

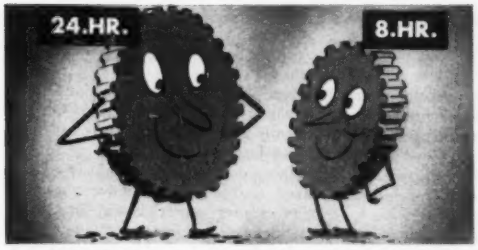
24-HR DAY steady loading or 8-hr day on moderate shock loads mean Class II. Here gear rating is 1.41 × motor rating

CLASS III



MODERATE SHOCK loads on a 24-hr basis or heavy shock loading 8-hr each day are best met with Class III gearmotor

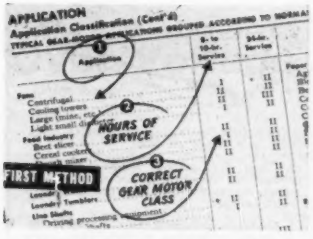
HERE'S FUNDAMENTAL RULE for selecting gear size



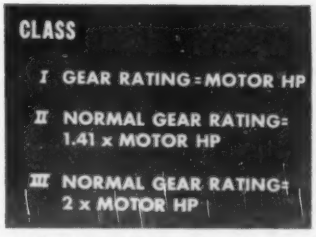
BIGGER GEAR always used for 24-hr service. Aim is to make wear-per-day same as that for smaller gear. Remember that . . .

. . . **GEAR WEAR VARIES** with time. For instance, Class I gear used 8 hr daily for 12 months equals 24-hr service for 4 months

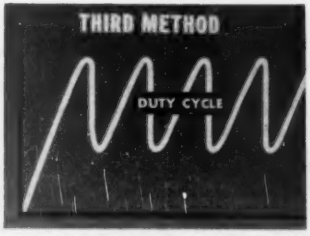
SELECT GEAR SIZES BY: 1. Handbook, 2. Gear classes, 3. Duty-cycle



MFRS' HANDBOOK solves most cases. To use, look up the application, check hours of service then pick gear class



IF JOB ISN'T LISTED fit drive into one of gear classes. Think of Class I for conveyors, II fans, and III for feed reels

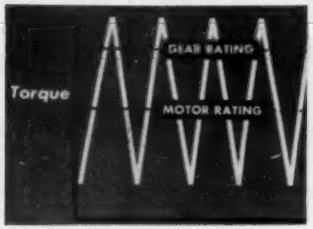


HEAVY DUTY-CYCLE loading brings in another angle. Fact here is that selection is based on max peaks, not average load

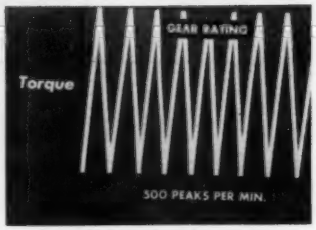
Continued next page

DUTY-CYCLE GEARING SIZE depends on load peaks

TORQUE-TIME CURVE clearly shows type load. With a fan that has a constant torque-time curve, such as above, both *average* and *actual* loads are the same. Here we select the gear based on hours per day service only. But the picture changes when load cycles. Motor rating still based on average load but . . .



. . . **GEAR RATING** falls somewhere between the motor rating and top of the load peaks. Just where depends on frequency of peaking. Consider too, number of starts, stops. Most motors have starting torques higher than rated running torques. These torque peaks create overloads like pulsating load. Where . . .



. . . **LOAD PEAKS** come 500 times a minute or so, the gear rating must be based on actual peaks. This would cause same gear wear as constant load equal to peaks. Reversing a gearmotor also causes torque peaks. So when you face a job that must reverse often, check this point carefully with motor manufacturer for Class

Individual or Group Drive?

Power transmission can mean single motor driving many units or separate motor for each machine. Each method has its place

► NO HARD AND FAST specific rules can be laid down on which is better of the two drives. But following fundamental advantages hold true.

Individual Drive. Machines located in a remote out-of-the-way spot are generally best powered by individual drive. But that's only the beginning. The following angles are important too:

1. *Special-purpose machines.* Machines needing two or more sources of power are often best operated by individual drive. This is particularly true if the machine's several shafts are at angles to one another or operate at different speeds. Of course if input shafts on machines are parallel, and are nearly similar in speed requirements, they may be group operated.

2. *Complex material handling.* You may meet up with plant layouts where the production plan is such that it would interfere with all possible group-drive arrangements. Individual drive is the only solution.

3. *Intermittent operation.* A large machine operated every-so-often is generally best powered through individual drive. This is true even if it is located close to many lighter machines on a group drive.

4. *Intricate control.* Speed variation, quick start and stop, remote control, etc, introduce additional problems in power transmission. Although modern group drive may be designed to meet practically all control requirements, it sometimes is more costly for intricate control than individual drive.

Group Drive. Looking over some of the fundamental advantages of modern group drive we first meet:

1. *Low motor cost.* Modern group drive uses relatively large and few motors. Large motors cost less per hp than small ones. For instance, a 40 hp motor may list at $9.10 per hp. But the list price of a ½-hp job is $90.20 per hp.

2. *Less hp.* Most machines have varying loads. When looked at as a group, one or more machines are usually out of operation at any time. Group drive must furnish power to meet only the average load requirements of group of machines. That means less installed hp than individual drives.

3. *Wiring and control.* Like motors, controls cost less per hp in larger sizes. And number of controls and wiring is reduced.

4. *Installation cost.* Except in rare cases the total installation cost of modern group drive is less than individual drive. Not only are individual-drive motor and wiring costs greater but frequently the mechanical drive cost is also much larger.

In addition group drive boasts lower fixed charges, lower power consumption, higher power factor, low drive maintenance.

So when all the cards are down it is obvious there is a place for both. But it means studying the particular job.

Power Transmission Council, Inc.

TO FIND LENGTH OF AN ENDLESS BELT...

1. Lay belt on floor. Lineup mark on belt with mark on floor

2. "Roll" belt without slipping till it makes one revolution. Then draw second chalk mark on floor corresponding to mark on belt

3. Distance between chalk marks is the outer circumference of belt. True belt lenght is a little less...actually it's the outer circumference (found above) minus belt thickness times 3.14

ELECTRICITY

Testing Your Insulation?

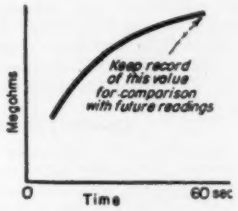
In a dither about insulation-resistance vs over-voltage tests? Does routine megohmmeter check take place of hi-potting? Actually, you need both. First, see that insulation tests clear with megohmmeter. Then hi-pot for voltage-strength

Insulation Resistance

SHORT-TIME TEST. There are three practical ways to measure insulation resistance with a megohmmeter: (1) *short-time* or spot reading (2) *double-reading* or dielectric absorption (3) *two-voltage* check. Let's delve into the simple spot-reading procedure.

This method calls for connecting megohmmeter across insulation to be tested and cranking instrument for a short time. Megohmmeter scale is read at the end of the period. That value is taken as insulation resistance. For a fast routine check this method is OK.

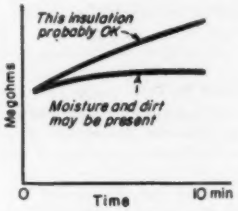
Just so you know how long to run this test consider the following recommendation: *Take the 500-v output of the megohmmeter and leave it connected for 60 sec for a standard short-time reading.*



DOUBLE-READING TEST. Value of a winding's insulation resistance will generally increase the longer you keep cranking megohmmeter. But for practical purposes a fairly steady value is reached in 10 to 15 min.

If winding is wet or dirty you'll get a steady reading shortly after test voltage is applied. This business of a steady reading for wet or dirty insulation and climbing reading for good insulation is called *dielectric absorption.*

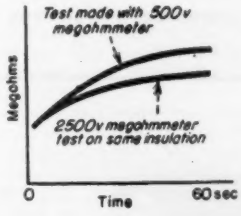
With hand-cranked megohmmeters it's more practical to run the test 60 sec, taking readings at 30- and 60-sec points. Take readings at the 1- and 10-min points with power-driven instruments. When the 60:30 sec ratio is below 1.25, or where 10:1 min ratio drops below 2, question the insulation's condition.



USING TWO VOLTAGES. Most routine insulation-resistance tests are made with a dc test voltage between 500- and 5000-v. Looking at sketch, note that insulation resistance drops as test voltage is upped. But for a difference of 2 or 3 to 1, in the usual test-voltage range, there is no appreciable change in resistance *for insulation in good condition.*

Say insulation resistance is first tested on the *short* time basis at 500 v. Then a second test is run on the same insulation at 2500 v. If you get as much as a 25% drop in insulation-resistance, there is probably too much moisture in the insulation.

Then, remember, it's not so much the minimum allowable values that count. It's a persistent downward trend that's a fair warning of trouble.



Over-Voltage Testing

► INSPECT, clean and dry windings before applying an over-voltage test. Low insulation-resistance reading on your megohmmeter does not always mean winding is unsuited for future use; especially if it's held on a steady keel month after month. But don't apply an over-voltage test until the insulation resistance is brought up to normal.

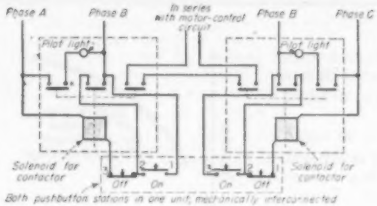
Accepted over-voltage test for new *armature windings* rated over 50 v is twice normal voltage plus 1000 v applied for one minute. But don't use this rule for machines that have seen real service. Here's a good rule-of-thumb: To find out if an armature winding is in good condition, choose an ac over-potential test voltage to ground about two-thirds regular proof test for a new winding. The approximate value would be (1 1/3 + 600).

Where over-voltage testing is adopted as a routine procedure use a still lower voltage, (1 1/5 + 400). Hold the voltage for one minute.

Make your over-voltage tests at the beginning of a planned overhaul period. Then you will have a chance to replace any defective coils that may show up without additional down time.

OOPS! WE MUFFED THAT ONE

Remember short item on protecting motors from single-phasing (July '51 Power, p 129)? Well we've since been peppered with letters from readers who feel (and we belatedly agree) that the hookup below won't work



It Just Won't Work

. . . motor will induce voltage in open-phase winding that will hold in solenoid coil. His best bet is thermal overload units.

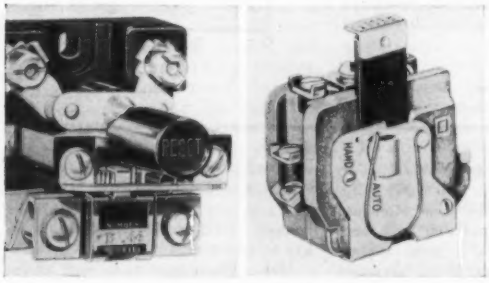
JOE COULDEN
Hamilton, Ontario

Can't Be Done

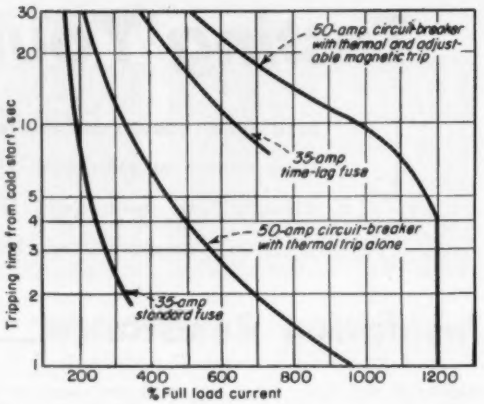
. . . beautifully simple but voltage generated in motor won't let solenoid drop out.

JIM SPARKS
Muskogee, Okla.

Following article on phase-failure protection will set you straight



THERMAL RELAY, left, has alloy-pool element. Top terminals in series with line. Unit to right may be adjusted to reset automatically or manually by simply making change indicated



TO GET ROUGH idea of tripping time for typical fuses, breakers, compare starting current characteristic of the load with above

Give Motors Single-

By **ERNST L SCHWARZ-KAST,** *Consulting*

► OPENING ONE PHASE on a three-phase circuit can cause trouble. An open phase can result from blowing a fuse in the feeder circuit, contact failure, etc. Of course if the load is lamp bulbs, heaters or single-phase motors, there's no real harm done. The snag comes when the load is polyphase motors alone or a mixture of polyphase motors and single-phase loads. And talking about polyphase (more than one phase), let's stick to the case of the three-phase motor.

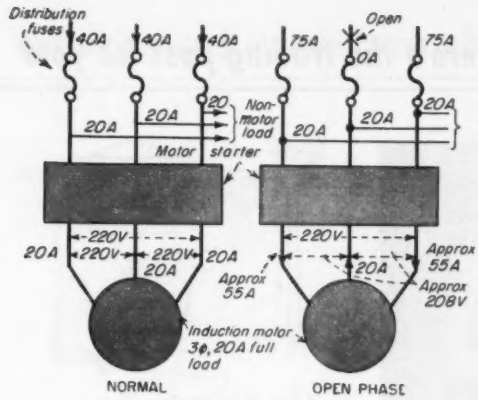
Here's What Happens. If one line to a 3-phase induction motor opens while she's running, the motor will continue to run but as a single-phase unit. *At the same time it acts as a single- to 3-phase converter. This means she will generate about full ac voltage and frequency in the "dead" third phase.* Meantime current drawn by the remaining two lines will be higher than normal.

In the case of the 3-phase motor, this current will be at least 1.73 times normal current. Actually this current will be still higher because of lower motor efficiency and poor power factor.

More trouble enters the picture if there's additional load on the "dead" phase. That is on same feeder but on motor side of open phase. Now voltage generated by converter action in motor's open phase winding supplies power to the single-phase loads (see sketch). This means even more current will be pulled through the two hot legs feeding the motor. Motor windings will overheat and if not shut down they'll burn out.

Remember the "dead" phase winding will always generate a voltage that's fairly close in value to the supply voltage. *Actually the difference between supply and generated voltage is so small no phase-failure device that depends on voltage alone can be used successfully at present.*

How To Protect. There are in general four ways to protect motors against overcurrent: Fuses, circuit breakers or thermal trips, phase-current-balance relays, temperature response from motor itself. But before digging into each of



HERE'S WHAT HAPPENS when phase opens in feed to 3-phase motor where there's a non-motor load tied in on same feeder

Phase Protection

Electrical Engineer, University of Chicago

these, keep in mind that the main reason for installing overload protection is to trip off the motor before she's damaged. On the other hand the overload devices should not trip out on normal motor starting or short-time overloads.

How big your starting current is depends on size and type motor and starting method used. In an across-the-line general-purpose squirrel-cage motor the inrush current is often between 500 and 700% full load current. Wound-rotor motors or squirrel-cage motors with reduced-voltage starting, often have a starting current about 300% of full load value. Now let's look at each of the four protective devices in that light. We can start by discussing . . .

FUSES

These are the simplest and least expensive type of motor protection. The *standard* fuse (without built-in time lag) cannot carry the required 700% or so starting current and yet give overload protection in the 125% range. So where starting currents are involved, the standard fuse is used for short-circuit protection rather than overload protection.

However the *time-lag* fuse can often be used in normal installations for both overload and short-circuit protection. On *abnormal* installations time-lag fuses of a larger size must be used. They will then give mainly short-circuit protection. Such cases are rare: where fuses are located in high ambient temperatures, motor is started frequently or reversed quickly, motor direct- or chain-connected to a machine that cannot be brought up to speed quickly. You'll meet such applications with centrifugal machines like extractors, pulverizers, large fans, machines with large flywheels, etc. Time-lag fuses have built-in thermal cutouts that allows momentary overloads and starting inrushes in addition to fuse-links that protect against short circuits. If overloads are sustained, the cutout part will operate. However size must be selected carefully to get maximum protection. You'll generally find plants select fuses for motor-branch-circuit protection (short-circuits and grounds). Then motor-running protection (overloading and single-phasing) is handled by thermal heaters built right into the motor starter. They usually have a pushbutton reset feature.

THERMAL RELAYS

One big advantage of the circuit breaker is they can be reset. And an overload in any one phase trips all three phases. All circuit breakers must have their tripping characteristic checked against load requirements (see sketch) to get maximum protection. Many breakers have both thermal and magnetic trips. Magnet coil opens circuit on short-circuit and thermal element handles overloads.

In this same group belong the popular overload thermal relays. They're the small "heaters" usually located in motor starter. When tripped they open the holding coil circuit of motor starter. Thermal trips are widely used to protect against single-phasing and overloads. These can be either the *melting-alloy* or *bimetallic* type (See Power July 48, p 88). Both depend on heat developed by current flowing through a series sensing-element to trip a toggle. This toggle in turn opens a contact in the holding coil circuit of the motor starter tripping motor off the line.

BALANCE RELAYS

Since a failure in any one phase will unbalance the currents flowing in each line, a *current-balance* relay gives most accurate and quickest single-phase protection. As long as all three-phase currents are about balanced, relay contacts hold open. But when phase currents become unbalanced (not the same number of amperes in each phase), the relay contacts close. This trips the main breaker or magnetic starter. But current-balance relays are costly. And since fuses, breakers and thermal trips do a good job, these relays have limited application.

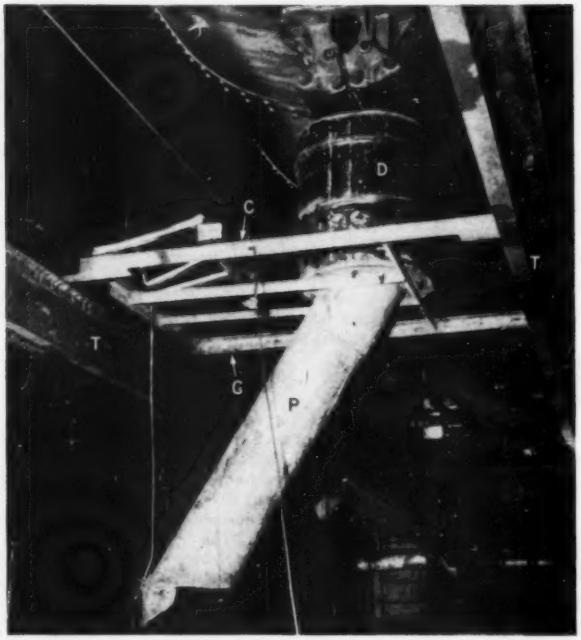
Building thermostats right into the motor is another good method of protecting against overloads and single-phasing. These respond to motor temperature regardless of why temperature rises.

Code. There are rare exceptions, but in general the *National Electrical Code* (1951 edition) requires only two overcurrent devices for protection of the motor against overloading. Incidentally, phase failure is mentioned in the Code only in paragraph 6243 in connection with elevator motors. And in paragraphs 4321 to 4325, dealing with general motor overcurrent protection, phase failure as such is not mentioned at all.

However the Code requires that motor overcurrent protective devices should operate at not more than 125% of the full-load current for motors with a 40C temperature rise. And at not more than 115% for all other type motors. But NEC Paragraph 4324 makes certain exceptions: "Where the values specified (125% or 115%) do not correspond to the standard sizes or ratings of fuses, non-adjustable circuit-breakers, thermal cutouts, thermal relays, the heating elements of thermal trip motor switches, or possible settings of adjustable circuit breakers adequate to carry the load, the next higher size, rating or setting may be used, but not higher than 140% of the full-load current rating of motors marked to have a temperature rise not over 40C and not higher than 130% of the full-load current rating for all other motors."

By following the Code you will automatically take care of phase-failure protection even if this hazard is not mentioned outright. Keep the 125% overcurrent figure well in mind. And as a parting shot, steer clear of the over-simplified hookups that depend on voltage alone.

PRACTICAL IDEAS... *here's the trading post for your*



OIL DRUM AND CHUTE SERVE AS COAL SCALE

EACH TIME the coal scales on our six boilers were out of service for overhaul we had to erect wooden chutes to put coal in the stoker hoppers. To eliminate this work our repair foreman built the traveling chute in the photo.

This equipment includes a light angle-iron frame carriage *C*, a cut-down oil drum *D*, and a piece of 12-in. light-gage iron pipe *P*. The assembly rides on the coal-scale track *T* and is easily pulled by a ⅜-in. rope from one stoker hopper to another. A mirror tilted at the right angle lets the operator see when the stoker hopper is filled.

This traveling chute is easily taken apart and stored when not in use. It is lightweight, and when needed can be assembled in a few minutes. Used at different times during the last three years, it has saved its cost several times.

WILLIAM BOYD *Cornwall, Ont.*

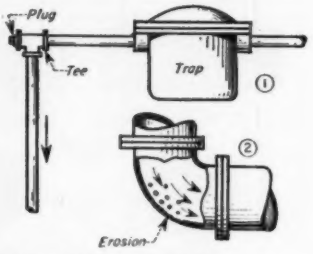
Holes in Draft Tube Drop Turbine Power

A HYDRAULIC TURBINE that had worked well for many years began to lose its power. We shut down the unit for overhaul, expecting that a new runner and other parts would be needed. But the runner was found in good condition. Except for a new set of gate links the turbine was ready to go back into service. But this did not account for the power loss that had increased 25%.

Getting down around the draft tube we found several holes eroded through it. Center line of the runner was about 8 ft above tailwater level and the total head 34 ft. Loss of the 8-ft draft head, because of the holes in the draft tube, easily accounted for the power loss.

A new draft tube raised the turbine's power to normal. To protect the new draft tube against the corrosive action of the water we gave it several coats of asphaltum paint.

R O BILLINGS *Chicago, Ill.*



Tees Resist Erosion Better Than Elbows

HIGH-PRESSURE CONDENSATES and vapor discharged from steam traps will erode elbows or other fittings if the mixture strikes them at high velocity. Elbows or tees in vertical waste lines are similarly affected, Fig 2.

For these severe conditions we replace the elbows with plugged tees, Fig 1. The plug takes the brunt of the eroding action of the liquid. In the corner formed by the plug the liquid tends to pile up and eddy. This action serves as a cushion that breaks the impact of the high-velocity liquid against the metal.

We find that a tee lasts much longer than an elbow under erosive condition. If the plug erodes, it can be easily replaced.

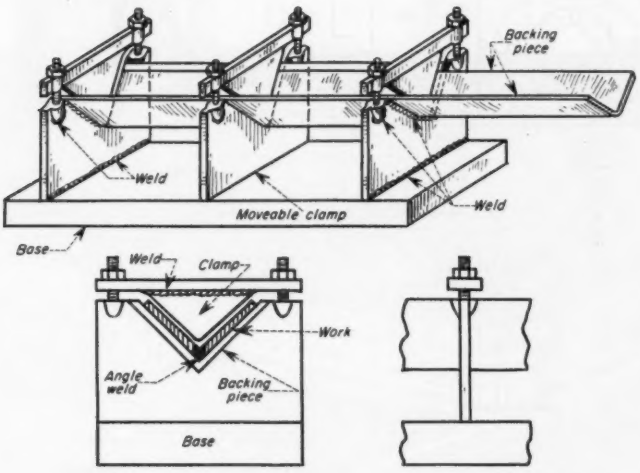
JOHN D CONSTANCE
Cliffside Park, N. J.

Takes no Chances With a Fuel Shortage

DON'T BE in too much of a hurry to get rid of a piece of equipment that has been replaced. It may come in handy some day. I ran across a case of this kind the other day, where a coal stoker had been replaced by an oil burner, in the plant of Williams Press, Albany, N. Y.

Philip Caird, superintendent of maintenance, who had been through war years with their sudden shortages, decided to play safe. He had the old stoker carefully removed, cleaned and packed in a box. Then he cleaned, greased and painted the conveyor and coal hopper and sealed them off with sheeting, ready to go back into service in an emergency. In time of need the old stoker may prove to be a friend indeed and save the cost of a new one.

GILBERT LINDGREN *Troy, N. Y.*



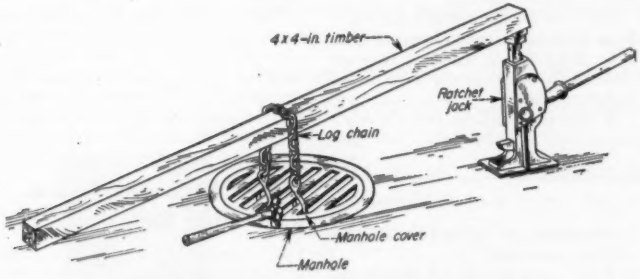
HOLDING RIG SIMPLIFIES WELDING ANGLES

WE NEEDED A LOT of angle irons made of special material. These were not available so we made them by welding. This presented the problem of holding flat strips in contact with each other at the proper angle and keeping them from warping while continuously welding.

Our welder made the holding rig shown in the drawing. Material from which he made the angle part of the clamp is heavier than that from which the special angles were made.

A section of angle was welded at a time. Then the clamps were released and the material moved to weld the next section. The movable clamp was advanced as needed to follow up the welding. Work proceeded rapidly with no warping of the material.

J A SWANSON *Princeton, B. C.*



JACK REMOVES MANHOLE COVERS

MANHOLE OR DRAIN covers usually are not removed unless it is necessary. Then they often stick and can't be taken off in a hurry. The figure shows how we remove these covers and strainers in floor drains.

We use a ratchet jack, a piece of log chain and a 4x4-in. timber.. Put a pull on the chain with the jack and tap the cover frame with a hammer. Take up a notch on jack and tap frame again.

Keep the hooks near the edge of the cover to reduce the strain on the web. I have found that the most stubborn cover yields to this method.

L E PILE *Cleveland, O.*

Double-Jointed Soldering Iron

SOLDERING in out-of-the-way places can be easily done with a soldering iron like that in the drawing. The iron is cut from its stem, drilled and tapped for a standard pipe thread. After that the iron can be arranged in any form with different-shaped elbows.

Length and position of the iron can be changed to suit the job. I have one in my tool kit, and can now do jobs that were thought impossible before.

STANLEY R WELLING *Racine, Wis.*

Loose Circuit Connection Overloads Electric Motor

A SHUNT MOTOR overheated as if overloaded. A check of the load and motor showed them in good condition and free to turn. We then found a loose connection at the power switch. When this connection was cleaned and tightened motor operation was normal.

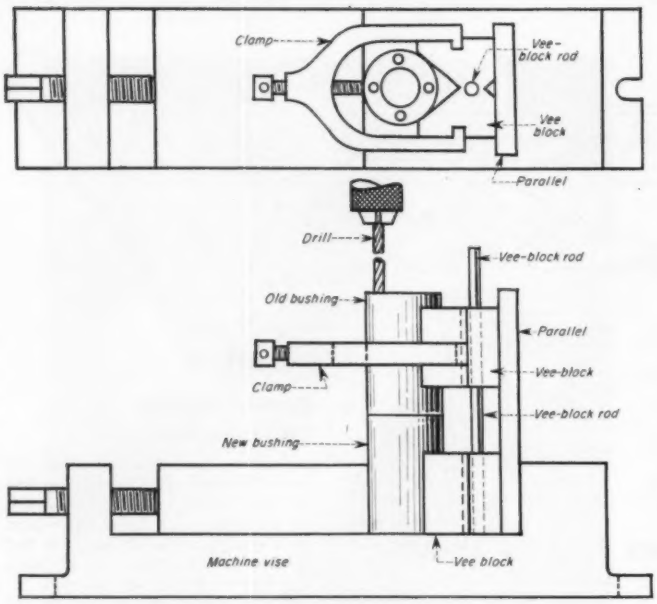
The loose connection increased line resistance and might be expected to have slowed down the motor and reduced its load. But the effects were not quite that simple. Increased resistance of the loose connection did reduce the voltage at the motor armature and tended to cause it to slow down. Voltage at the field coils was also reduced. This weakened the field, which tended to increase the speed.

The two effects were such that the motor's speed did not decrease in proportion so had to drive about the same load as at rated voltage. As a result, its armature current had to increase with motor-temperature rise.

A M HOBART *Lynchburg, Va.*

More PRACTICAL IDEAS on page 126

Begins on page 124



OLD PART LOCATES HOLES IN NEW

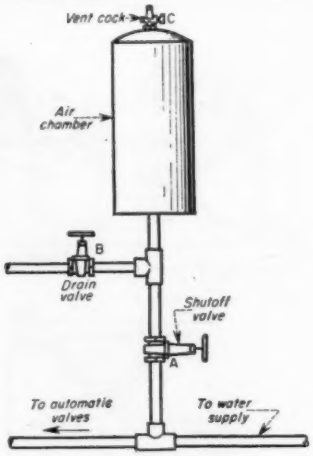
MAINTENANCE WORK often requires making parts to replace worn ones. These often match up with others in a machine not readily available to locate holes in the new part. For such work I use the clamp in the drawing to produce exact duplicates.

The clamp has a pair of V-blocks that have a hole for a rod to hold them in line. When we have to make a bushing with blind holes I put the stock for the new one in the V-block. With the parallel behind the block, I grip the assembly in a machine vise.

Next, I put the old part in the other V-block and slide it down on the rod. Both bushings are now in good alignment in a vertical line. When the vise is tightened down with the drill in one of the blind holes, I take the top V-block off the rod and drill the blind hole in the new bushing.

When the hold is drilled I put the V-block back on the rod to locate the next hole. When the job is done all holes are drilled as they are in the old part and match accurately.

H MOORE *Hamilton, Ont, Canada*



Simple Air Chamber Stops Water Hammer

AUTOMATIC VALVES control water to the large washers in our laundry. These valves closed so quickly they caused a heavy water hammer. Casing on one of these valves cracked and after being brazed it cracked again.

To correct the trouble we put an air chamber back of the automatic valves, as in the drawing. The air chamber is made from a 5-gal tank. Air in the tank is that which goes in at atmospheric pressure and is compressed by the water. This is enough to prevent water hammer.

Once a week when the washers are not in use, we close valve *A*, open drain valve *B* and vent *C*. This drains the tank and puts in a new air charge. Doing this keeps the tank from getting water logged; prevents water hammer.

JAMES F MAHER *Shiprock, N. M.*

Electric Clock Checks Equipment Running Time

IT'S EASY to find the operating time of oil burners, sump pumps or other small 100-v equipment doing off and on duty. Connect a self-starting electric clock across the motor terminals. Set the clock at twelve and the second hand to match.

The clock starts and stops with the motor. The sum of all running periods of the equipment will be totaled on the clock, which can be read once a day and the clock reset.

When used on an oil burner the amount of oil burned can be determined from nozzle size, pressure and time. Likewise when the clock is connected on a pump motor, amount of water pumped is found by the pump's rating in gpm and the running time in minutes. We have used an electric clock this way several times and find that it does the trick.

W T ESTLICK *Ansonia, Conn.*

Makes Recorder Charts Do Double Duty

FOR A number of years we have saved in cost of single-pen recording-meter charts. One year we date the charts with a green pencil and use green ink in the recorder pens. The charts are filed in daily order. Then, the next year they are redated with a red pencil and red ink used in the recorder pens. This gives a comparison of records for each day of the year, besides the saving in cost of charts.

F HECKMAN *Boonville, Mo.*

Commemorating our 60th Anniversary

THE POWERS REGULATOR COMPANY

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World's Most Modern Factory Producing Automatic Temperature and Humidity Control

. . . to meet the greatly increased demand for POWERS products and to give you better controls, better deliveries and better values . . . these advantages are possible with our large new plant and modern production facilities. With an enlarged engineering and production staff, plus 60 years experience in heating, ventilating, air conditioning and process control, we believe we can be of greater service than ever before to our many friends who have contributed to our success.

WILLIAM PENN POWERS
. . . with his invention of the first all pneumatic system of temperature control and gradual acting vapor disc thermostat made an invaluable contribution to the modern science of heating, air conditioning and industrial process control.

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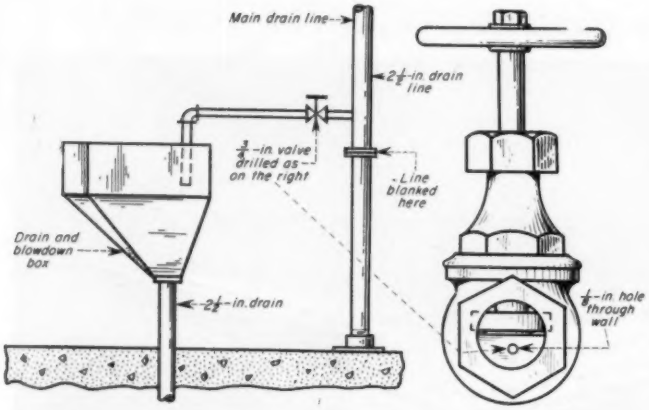
(a55)

More PRACTICAL IDEAS

Begins on page 124



VALVE IMPROVES SOOT-BLOWER OPERATION

BECAUSE OUR FOUR BOILERS are about 40 ft high from floor level, soot-blower main pipe is quite long. Main and branch pipes to these blowers are 2½ in., extra heavy, electric welded. Tube-blowing periods are increased because of two retractable blowers in each boiler front wall. These blowers are operated by hand and clean the over-furnace tubes.

Condensate collects in the lower end of the main steam line, when soot-blower steam valve is first opened. This is removed by partly opening a ¾-in. globe valve in the drain line to the blowdown box, as in the drawing. When the line heats up, the valve is closed.

To prevent condensate collecting in the line after the drain valve is closed, we drilled a ⅛-in. hole through the valve's wall, as in the right-hand drawing. This keeps the line drained and insures dry steam for blowing, especially for the retractable units cleaning the over-furnace tubes.

Steam for blowing comes from the rear upper drum, but it was not dry enough until we continuously drained the main steam line to the blowers.

ARTHUR BELTON *Montreal, Que.*

BE SURE OF YOUR WELL-WATER LEVEL

WATER for a gas cooler was pumped from a well 84 ft deep, but the water in it came to within 6 ft of the ground surface when the pump was stopped. The well had a 3-in. casing in which was installed the 2-in. suction line to the pump at ground level.

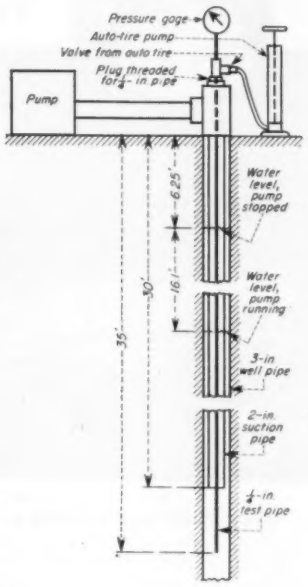
More water was needed than the pump could deliver. The pump was not in good condition so I suggested that new parts be obtained with which to do a good overhaul. Instead a larger pump was ordered and installed, but it failed to come to rated capacity.

I was called on the job again to answer why. My opinion was that maybe the well did not have sufficient water. We made a check of water level when the pump had been standing some time and after it had been running. Water level was tested as follows:

The suction line went down 30 ft in the well so we got some ¼-in. pipe and assembled a 35-ft length to make the test. There was not room between the well casing and suction line for this pipe so we put it inside the latter. We took the plug out of the suction-line tee then drilled and tapped it for the ¼-in. pipe. We cut a long thread on this pipe and threaded the plug tightly on it and locked it in place with a tee. The assembly was lowered into the suction line and the plug screwed into the 2-in. tee as in the drawing.

After connecting a pressure gage and tire pump to the ¼-in. tee we pumped air into the pipe until the gage held constant at 12.5 lb. At this pressure the air had forced the water out of the ¼-in. pipe and was leaking by its end.

Pressure of 1 lb equals 2.3 ft of water.



So, a pressure of 12.5 lb equals 12.5 x 2.3 = 28.75 feet of water in the well above the lower end of the ¼-in. pipe 35 ft long. Water level then came up to 35 — 28.75 = 6.25 ft from the top of the well.

We then let the pump run for a while and checked the well-water level again. This time the pressure gage held constant at 5.5 psi or 5.5 × 2.3 = 12.65. So water level stood at 35 — 12.65, or 22.35 ft from the top of the well. This meant that the pump was operating against a 22.35-ft suction lift. Evidently it would do no good to increase the pump speed to get more water. Instead of getting more water we might increase the drawdown and get less.

If the old pump had been put in good operating condition it would have supplied as much water as the new one. When you try to get more water from a well, be sure it is there to get before you put in a larger pump.

All deepwell pumps should have a drawdown pipe in the well. This pipe is usually placed between the wall casing and the suction line and should extend below this line. With this pipe the operator can easily check water level in the well. Many times a pump, because of low capacity, is judged as being worn when the water is low.

GEORGE G AVANT *Wilmington, N. C.*

puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

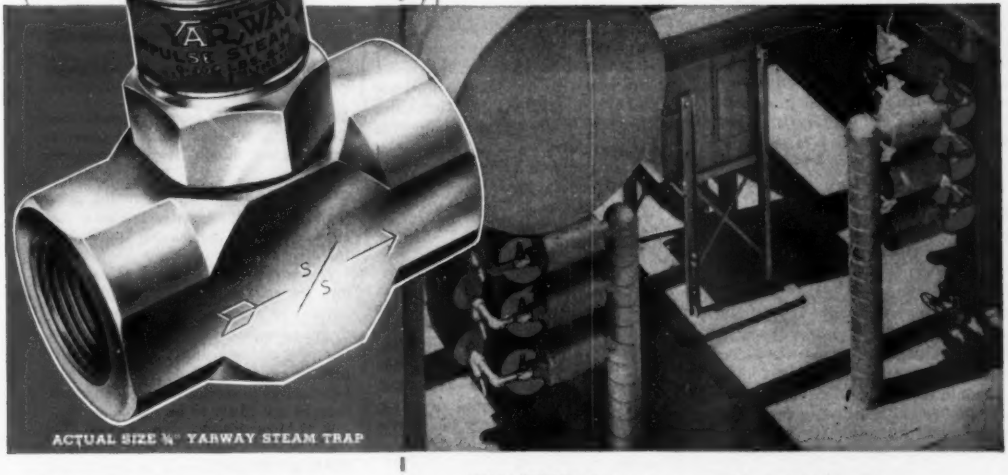
(2) Three men formerly required to service old-type traps can now be used for productive work.

Significant sidelight—these Yarway traps are operating under severe conditions, many outdoors with temperatures often below zero.

Plant after plant is standardizing on Yarway Impulse Steam Traps because Yarways are designed to deliver the most premium B.T.U.'s at top temperatures into your process or product. **They get equipment hotter, sooner ... and keep it hot.**

Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

Buy your Yarway Impulse Steam Traps from the nearest of 216 distributors. For name, write us.



ACTUAL SIZE ¾" YARWAY STEAM TRAP

YARNALL-WARING COMPANY
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FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

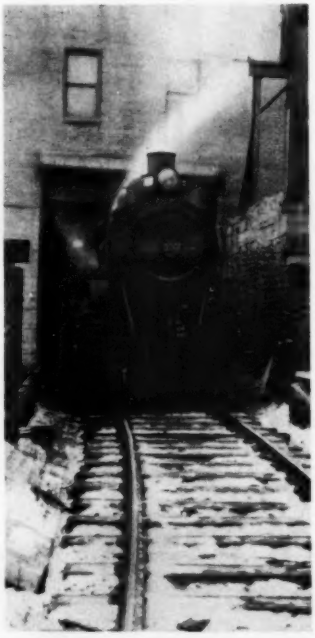
YARWAY the steam trap
designed with more production in mind

PLANT PROBLEMS . . . *put your know-how to work . . .*

HOW CAN WE GET STEAM IN EMERGENCY?

HERE ARE THE FACTS: Our central heating plant has seven pulverized-coal-fired boilers. In cold weather we generate up to 250,000 lb of steam per hour. If we lost our steaming capacity from sabotage or other causes, several thousand people would not be able to work because we have no stand-by equipment to produce heat. Besides, we'd have all sorts of trouble with frozen lines, traps and valves.

How can we produce steam during an emergency? Locomotives have been suggested. They could pull into our siding and be hooked into the steam lines. Will locomotives do this job? How are they rated? What connections do we need?—HS, June POWER



SWITCH ENGINE from Baltimore and Ohio RR Co supplied heat and power to shoe factory during 6-week emergency

HERE ARE THE ANSWERS

PLANT IS PLENTY FLEXIBLE as is and could probably carry heating load under most circumstances. *HS* must test to see if one boiler and pulverizer will handle heating. If it won't, a hand-fired boiler to burn solid fuel could be used. Locate remote from main boiler house.

Locomotives are suitable for emergency service, but history of recent warfare shows that in extreme emergencies they are far more valuable for other jobs like hauling repair materials. Local civilian or military authorities would probably use them for such duty.

A M PALMER *Brooklyn, N. Y.*

ELECTRIC STEAM GENERATORS are more practical than locomotives and could be kept on standby service for months or years. Three units, each rated at 25,000 kw, would probably be suitable for this plant. While they'd need large blocks of power to operate they are just as reasonable a proposition as locomotives.

Should *HS* decide to use locomotives, injectors would be all right for feeding and ejectors for return. If coal evaporates 10 lb of water per hour, 25,000 lb of coal per hour must be burned to meet his maximum demand. At an accepted burning rate of 120 lb of coal per sq ft of grate per hour, 210 sq ft of grate area is needed.

R A LANE *Three Rivers, Que.*

LOCOMOTIVE DETAILS. Here are facts *HS* will find helpful if he decides to use locomotives for emergency service.

Locomotives are completely self-contained, include stokers, superheaters, feed heaters, water pumps and injectors. Steam pressures range from 200 to 300 psi. Tender capacities range from about 8000 to 25,000 gal. Average locomotives on passenger and freight service supply 35,000 to 60,000 lb of steam per hour.

Boiler connections, except for blowdown and feed inlet, are generally at the top, resemble locomotive-type powerplant boilers. When locomotives are used as auxiliaries, safety valves are usually removed and placed in steam header which is piped to safety-valve nozzle. Return condensate is piped to tender, from where it is pumped to feed heater before entering boiler. Using return condensate may better locomotive performance because their average feed temperatures are 40 to 50 F.

L W FITZPATRICK
Jefferson City, Mo.

RR FIREMAN IS NEEDED. Remember, railroads won't rent or lease a locomotive without their fireman attending. Allow about 6 sq ft of heating surface for every 34 lb of water evaporated. Locomotive boilers are rapid steaming, can be forced easily. Pump condensate to tender through hoses, or discharge to sewer.

JOHN M GORRIE *Richmond, Va.*

USE AUXILIARY GENERATOR, gasoline or diesel driven, to run one pulverizer and i-d fan. With these going *HS* can raise steam in one boiler, then get rest of plant turning over. Locomotives may require long lines to boiler plant, supports and insulation for the pipe and usually are troublesome when it comes to connecting steam and condensate lines.

VINCENT STROJSA *Glace Bay, N. S.*

COMBAT SABOTAGE by planning plant to minimize effect, enforcing strict security measures and having spare parts for critical items on hand.

HS won't find locomotives satisfactory for emergency steam supply for a number of reasons. He'd be very lucky to get enough engines to prevent freezing of buildings and pipes in winter because railroads are reluctant to assign locomotives to service off the road. Also, charges are likely to be high.

W M MONTGOMERY *Des Plaines, Ill.*

STANDBY BOILERS would be better than locomotives. They could be used at any time during life of plant and in all kinds of emergencies too. Not only that, they're handy when a unit must be shut down for maintenance.

A J BREUGELMANS *Hoboken, N. J.*

KNOCKING OUT PLANT TOUGH. It seems far fetched that a saboteur could knock out a complete plant of this size. One or two boilers might be put out of service, but a direct bomb hit would be needed to stop production in the en-

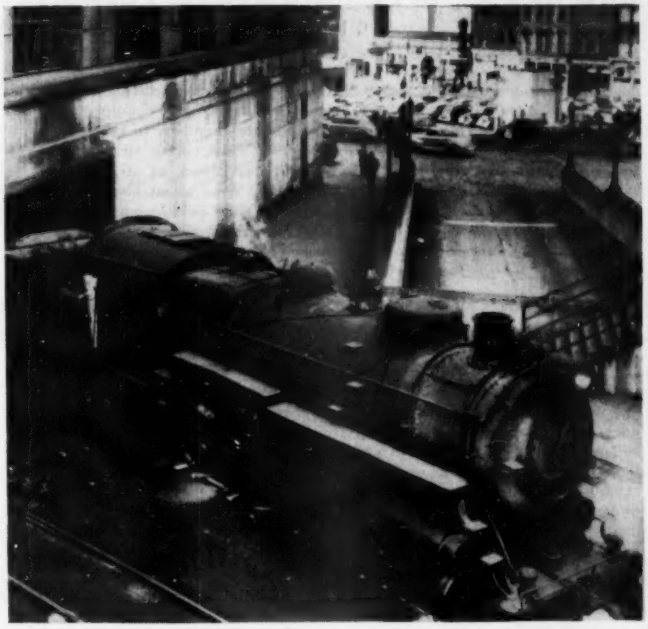
. . help the other guy cure his headaches

TYLER HICKS, *Assistant Editor*

tire plant. If that happened there isn't much *HS* could do for immediate remedy.

During the last war we used two locomotives for emergency service when our pulverizer gears shattered. Each freight loco was said to have a 40,000-lb-per-hr capacity, but the best we could get from each was 20,000 lb per hr. We finally switched to homemade oil burners. They cured our trouble and might work well for *HS*. Don't forget to install a bridgewall, if needed.

W N Davis
National Safety Council, Chicago



BUILDING HEAT for a 10-story building was supplied by this Pennsylvania RR locomotive during a power strike. Engine was backed into building's siding, blocked in place, hooked into the steam lines

THREE LOCOMOTIVES from New York Central System on siding outside a steel plant feed steam to plant for process and heating. Note tall stacks on locomotives

STEAM PIPING for New York Central System locomotive serving steel plant during an emergency. Hookup gave good steam supply during entire emergency

(More on next page)

More PLANT PROBLEMS

Begins on page 130

HOW CAN WE CLEAN AIR DUCTS, PLENUMS?

HERE ARE THE FACTS: Our industrial plant is completely air conditioned. We must keep dust out of work areas because it spoils manufactured goods, increases rejects. Our manufacturing spaces are divided into a number of small rooms served by supply and return ducts. These run from large plenum chambers in basement. Two fans and air washers supply air, the fans taking air in from above the building roof. We use standard filters in air intakes.

We get complaints from manufacturing areas about large quantities of dust entering rooms. We often find dust around return grilles in many rooms. We've tried several schemes for removing dust from ducts, but none have worked well. What is best way to do this job?—GS, June POWER

HERE ARE THE ANSWERS

TRY COMPRESSED AIR. We clean our ducts with a compressed-air lance. Results are good. But it looks to me as though *GS*'s trouble is from one of these conditions: inefficient or overloaded filters, dust returning through discharge ducts when system is shut down, inefficient humidification or too-high air velocities. Check filter and fan ratings against actual air quantity handled. Anemometer and hygrometer are useful for system checks.

R A Lane *Three Rivers, Que.*

FILTERS IN PLENUM CHAMBERS would do good job. Oil-bath filters having motor-driven belt that passes through an oil reservoir are good for this service.

Melvin Evans *Chicago, Ill.*

OVERLOADED FILTERS or under-capacity filters may cause trouble. Or contamination from some outside source may be throwing heavy load of dust and dirt on filters. Also, some systems act like a stack, draw in dust-laden air during shutdowns.

Other possible causes of dust entering manufacturing areas are dirty, unconditioned water supplied air washers, return ducts that are too small.

Clyde G Howarter *Canton, Ill.*

THROWAWAY FILTERS made of paper and installed in duct as near room outlet as possible solved a similar problem for us. They trap any dust that has passed the main filters, preventing its entrance to the room. Throwaway units will also eliminate need for cleaning small ducts because dust won't accumulate in them. Large ducts and plenum chambers may be cleaned without danger of loose dust being blown into rooms.

E J Denn *Brooklyn, N. Y.*

USE SUCTION HOSE. Mark hose and duct at 3-ft intervals. Insert hose in duct through an access door and push through duct. As each mark on hose lines up with duct opening, vibrate four sides of duct at corresponding mark with a rubber-cushioned air hammer. Thus, when 12-ft mark on hose is at access door, you vibrate the duct at its 12-ft mark. Loose scale, dirt and dust will be removed by hose. Move hose from side to side inside duct so all dirt is removed. Install temporary cloth screens at all outlets to catch residual dust after vibrating and vacuuming.

Be sure to check inlet and recirculating air filters for overloading. Also look for cracks or other openings in duct seams and joints.

A J Breugelmans *Hoboken, N. J.*

ANALYZE DUST to determine if its origin is within or outside plant. If outside (flyash, road dust or wind-blown soil) install filters for all air intakes. Viscous-impingement filters are good for this job. Calk windows and fit with weather stripping to keep external dust out. Keep windows closed at all times or the filter system may be bypassed.

Dust originating inside plant can come from wood-shaving and grinding operations, potato, talc or cement bags, unpainted concrete floors and return air. Use filters to remove this dust, being sure that air velocity through filters is low enough for efficient operation.

A M Palmer *Brooklyn, N. Y.*

INADEQUATE FILTERING and leaks in duct system are main cause of trouble. Depending on pressure in duct, dust may be drawn in through small holes and cracks. Also, dust may enter return ducts from manufacturing areas in different parts of the plant.

Don't use return air from badly contaminated areas. Use clean air for makeup. Packaged electrostatic precipitators are useful for cleaning air containing various impurities.

Here's a fast way for removing dust from air ducts. Make a dummy cover plate for duct louver, sealing it with a sponge rubber gasket where it seats on louver. Fit an opening in center of cover plate for entrance of a compressed-air hose. Insert hose in opening and give a blast of air to blow dust to atmosphere. Close other sections of duct system while blowing air from one duct.

L W Fitzpatrick *Jefferson City, Mo.*

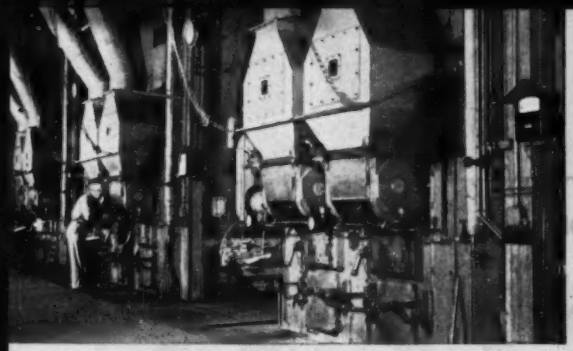
MORE THAN DUCT CLEANING. What *GS* is interested in is supplying clean air to manufacturing spaces. So his problem is more than one of simply cleaning air ducts.

Firms that specialize in duct cleaning first vacuum them to remove dirt, lint, etc. Then interior surfaces are cleaned with a solvent, either by remote swabbing or by having a man enter duct and scrub it. Surface-film removal is important because film is tacky and holds dust.

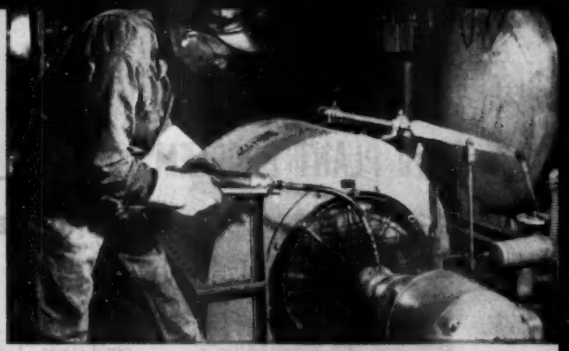
Remove dust from air supplied room with air filters in plenum chamber. For maximum effectiveness use some type of electrostatic precipitator, p 134. In some plants precleaner filters, p 134, remove majority of dust load from outside air before it reaches electrostatic unit. Return and outside air are then passed to electrostatic filter. With this type of filtration there's little possibility of ducts becoming dirty. Of course ducts should be clean at start.

Dust generated within manufacturing space and that which enters by infiltration are other sources of contamination. Stop infiltration by keeping the space under a slight positive pressure and fitting air locks at all entrances. This is important because rooms needing clean air are often close to spaces where dust concentration is high.

To prevent dust formation in manufacturing areas, keep them clean. Occupants may have to wear full-length smocks and hoods to prevent contamination by hair, dandruff, etc. Floors often need special treatment so dust gener-



TO GENERATE STEAM for manufacturing, Triangle Conduit and Cable uses three 350 hp boilers. Each unit generates 22,500 pounds per hour, 24 hours a day, 5 days a week. *Sun Solnus Oil* lubricates the spreader stoker oil bath, *Sun 844 Grease* the pulley drive, stoker motor and pillow block.



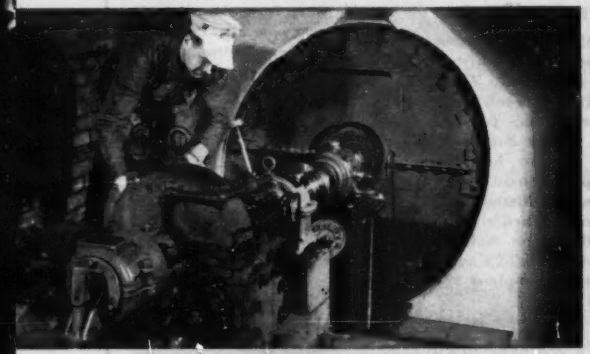
TO CONTROL THE AMOUNT OF AIR entering the fire box, three forced draft fans are kept in constant operation. The motor and fan bearings and the speed reducer motor are lubricated with *Sun 844 Grease*, while the gears and reducers are protected by a *Sun* gear oil.

MODERN POWERHOUSE ENTIRELY SUN-LUBRICATED

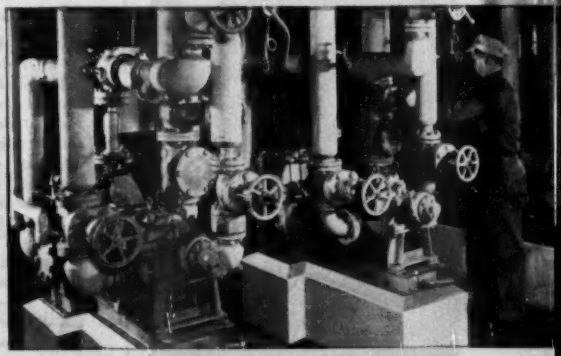
Triangle Conduit and Cable produces flexible and rigid electrical conduit and cable. Its modern powerhouse generates steam for galvanizing pipe and for heating the factory, the pickling vats and the enamel paint vats prior to dipping the pipes. From the very beginning of operations more than two years ago, Sun oils and greases have been used exclusively in all the equipment, and there hasn't been a single failure because of faulty lubrication.

This modern powerhouse is wholly lubricated by Sun "Job Proved" products and the factory partly so. In both, Sun's engineering know-how has effected purchasing and inventory economies through multiple use of a minimum number of oils and greases.

For technical assistance or a copy of the manual "Lubrication of Industrial Machinery," write on your business letterhead to Department P-9.



TO HELP GET PROPER COMBUSTION in the boilers, three exhaust fans are used. The turbine which drives them turns up 3,600 rpm. The engineer says the lubricant, *Sunvis 951*, looks like new when it is changed to get rid of condensate.



TO FEED WATER TO THE BOILERS, two 3,500 rpm turbine-driven pumps are employed. A motor-driven pump is used in starting up when there is no steam pressure. *Sunvis 951* lubricates the turbines, *Sun 844 Grease* the pump fittings.

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

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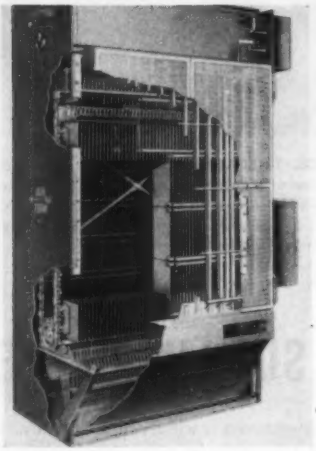
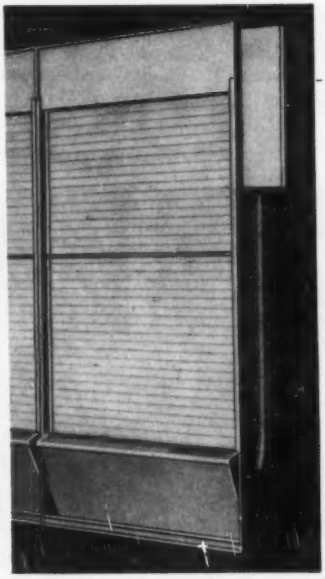
More PLANT PROBLEMS

Begins on page 130



ELECTRONIC precipitator is automatic, gives extremely clean air supply to room



PRECLEANER used ahead of electrostatic precipitator is an automatic-type unit

ated by normal wear and carried by foot can be reduced to the minimum. Start with clean air and keep a clean plant at all times.

JAMES W MAY
American Air Filter Co, Inc, Louisville, Ky.

MORE ON SAFE STARTS OF INDUSTRIAL BOILERS

Another answer to POWER's April question

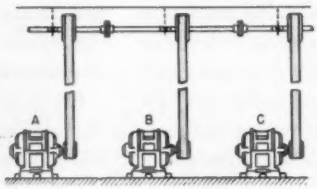
***ER* HAS WRONG SLANT** on operation of 400-psi boilers when he talks about rapid starts. Any boiler must be given time to warm up, even though it is banked. You can't make rapid starts indefinitely and get away with it. In an emergency it's a different proposition. You must do it in a hurry.

ER should keep his loads at a point where he can up rating if necessary. This safeguards superheaters. Sudden variations in loads or temperatures aren't conducive to low maintenance or high efficiencies. This is especially true in high-pressure boilers where drum thickness is greater. Keeping a boiler floating on the line is another method of ensuring rapid increase in load without possibility of harm.

R A LANE *Three Rivers, Que.*

YOUR NEW PROBLEMS

Will you help these two readers, who have sent their problems to *Power*? Published answers are paid for. Extra for photos, sketches



1—Why Are Loads on Motors Unequal?

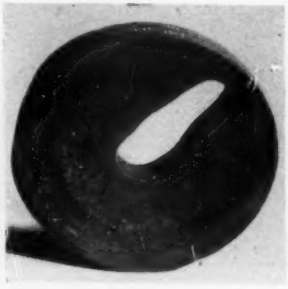
IN OUR PLANT we have three 75-hp induction motors driving a line-shaft as in sketch. When motor *A* carries entire friction load, it draws 47 amp per terminal; when *A* and *B* operate together on friction load, *A* draws 42 amp per phase. With all three motors on friction load *A* takes 35 amp. When all motors drive full load on shaft, *A* takes 135, *B* 85 and *C* 75 amp. Motors operate on a 3-phase 60-cycle 440-volt system.

I'd like to know why motor *A* takes more load and operates at a higher temperature than either of the other two machines. What can we do to balance load between motors?—PR

2—What Caused this Pump Valve to Wear?

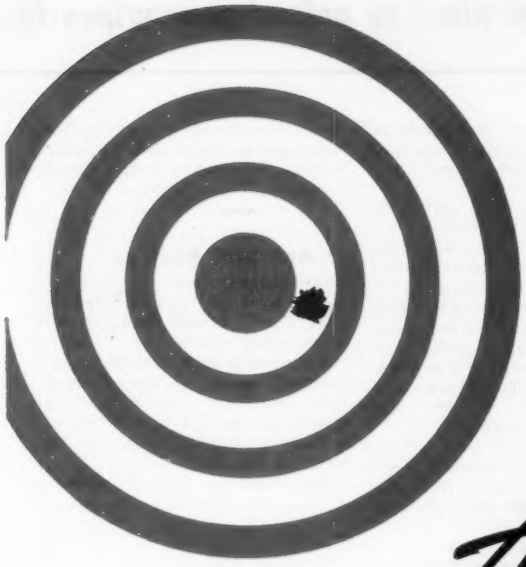
Our simplex horizontal vacuum pump handles condensate returns from our steam heating system. Eight months ago we installed four new suction valves, seats, springs and stems. Pump operated well at first, but gradually lost capacity until it wouldn't move any water at all.

We opened it and found all four suction valves had worn at the hole as shown in photo below. As you can see, there's a slot about 1½ in. long and ¾ in. wide worn from the original circular stem hole almost to the edge of the composition valve



disk. Sides of the slot are smooth and vertical without pits or grooves. Width is fairly uniform.

What caused this wear in the four valves? How can we prevent it in the future? We need good dope on best way to cure this trouble—VH



Almost

ISN'T GOOD ENOUGH!

Especially when you're buying a water conditioning service!

Sound engineering ability is easier to claim than it is to prove. In fact, the phrase has been used so indiscriminately that it has lost much of its true significance. But here at BETZ, we have never lost sight of its real meaning.

Sound engineering ability has always meant "*completely outstanding performance*" in the water conditioning service bearing our name. There is over two decades of continuity in our efforts to offer a nationwide water conditioning service that is scientifically correct—designed to help you cut plant operating costs. May we show you how and why?
W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

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BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

ARGUMENTS... *here's the place to unload your gripes to*

Psi Isn't Greek

EVERY NOW AND THEN I bump into an engineer who is bothered by such abbreviations as "psi," "psig" and "psia," which appear often in POWER. They're all Greek to him, he says.

Now, I can't blame him for this idea, because psi does happen to be the English spelling of a Greek letter, although that's just a coincidence.

When you see "psi" in POWER it means only one thing—"pounds per square inch," referring, of course, to pressure.

Most of the time when we're talking about pressure, it's understood we mean gage pressure, but if there's any doubt about it we clear it up by talking about "pounds per square inch *gage*" or "pounds per square inch *absolute*."

So, look at this: "psi" means "pounds per square inch"; "psig" means "pounds per square inch, gage"; "psia" means "pounds per square inch, absolute."

Nuf said! Any more questions?

PHIL SWAIN

Better Method for Handhole Plates

OPERATOR'S NOTEBOOK 43, July, p 118, 'Now You Can Slash Handhole Plate Time' is a good article. From the looks of the boiler, it must be a sectional header, B & W. But this method would not be suited for a box-head boiler, similar to an Edgemoor. We have a different method at our plant.

1. Start at bottom row and loosen all nuts with a box wrench. When nut is fairly loose, knock in each plate, with dog still attached.

2. Have another man remove dog and plate. Dogs are removed and nut screwed back on stud and placed on floor.

3. Crew on floor removes gasket and examines thread on stud.

4. Start turbining tubes after about four rows of plates are removed.

5. Remove rest of plates while tube cleaner is in operation. Have night men clean gaskets from handhole plates.

6. Since we use a water-driven tube cleaner, the water tends to lossen any broken pieces of gasket on the head. Examine seats before plate is replaced.

About soaking the gaskets in water to make graphite stick, our gaskets come already coated with graphite.

Each time we take a boiler off the line we tighten up on handhole plates before washing out boiler. Reason is that as boiler cools, gaskets shrink slightly and nuts loosen.

GEORGE G AVANT

Wilmington, N. C.

...And Another

HERE'S MY METHOD: In step 5, Steve Elonka slides the handole plate across the floor plate to remove the gasket. That damages the plate seat. You may even have to resurface some of the plates after that operation.

I use a No. A-42 wire brush. First I remove old gasket with the scraper edge. Then with plate still in my hand I wire brush the plate seat, doing two operations at same time.

For operation 12, I also use a wire brush. It's just as effective as a special scraper and a lot easier.

Operation 13 is useless as a good boiler mechanic can install the handhole plates so they will center.

If, as in 15, the plate needs to be recentered to stop a leak, it's a lot easier to use a small ball-peen hammer than a two-foot wrench.

Here's a trick I found very good on B & W-type sectional-header boilers: After header and handhole plates are buffed clean of old gaskets with No. 28 cup-type wire brush, lay gaskets on floor and shellac plate joint surfaces. After about four hours, the gaskets dry in place. Then they won't slip.

We also use a power driven wrench to loosen all plates when we turbine our tubes once a year.

S A GREEN *Trona, Calif.*

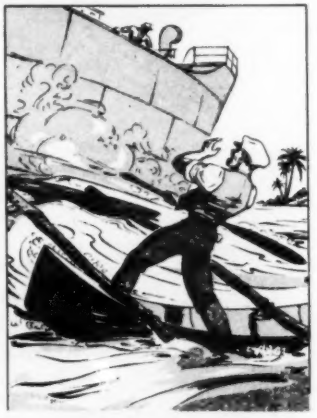
EDITOR'S NOTE: *What do you readers think about shellacking handhole gaskets? I ran into shellac on one job and it took "dynamite" to remove gaskets from the plates after they had been baked on. And I don't think shellac helps water side of boilers.* STEVE ELONKA.

...And Still Another

STEVE ELONKA missed the most important point on "Slashing Handhole Plate Time." I mean using an air-driven impact wrench.

Anyone with box-header or serpentine-header boilers can warrant one of these tools. I've skinned many a knuckle pulling on a hand wrench as he shows in the first picture. I'll bet Steve did too.

K M WHITE *Linn, Mo.*



Any Packing 'In a Storm'

I GET A KICK OUT OF all the book engineers raving about Yarbrow's letter telling how he packed a stuffing box with his felt hat. What's all the shootin'? Didn't you guys with the 'book learnin' ever work in a plant out in the jungle? If you did, you'd know you can't call up a supply house and order the packing you *should* have. Fact is, there's no supply house around.

When I first worked at a mahogany lumber mill in the Philippine Islands, I found I had to pack steam pumps and engines with rope, canvas strips and everything else.

Finally, after three weeks of going nuts, I paddled four miles down the coast in a fisherman's outrigger and bummed a box of packing from a Dutch

editors, manufacturers, fellow engineers

STEVE ELONKA, *Associate Editor*

merchant ship. The point is; we kept the plant running in the meantime in whatever way we could.

But I'll admit there's no substitute for the right packing for each job.

R R McCALL *New Orleans, La.*

Let's Do It The Easy Way

C J TROSKE, May POWER, p 130, won't have to use either gloves or mechanical means to agitate his chemicals if he'll use this system.

Hang a screen tray on top of the tank big enough to hold the amount of soda ash needed. Then stick a steam pipe with an elbow and short nipple down into the tank close to the side.

The steam nozzle causes a swirling action that gradually dissolves all the chemical. Steam is used instead of air because air puts oxygen into the water.

We used this method for tannin which is much harder to break up than soda ash.

ED J DUFF *Aurora, Colo.*

Rigid vs Flexible Couplings

THE APRIL ISSUE of POWER certainly gave us our money's worth but I have one gripe to unload. It concerns Frank Cowan's "One Bolt Coupling," p 109.

Connecting a motor to a driveshaft by using a rigid coupling is asking for trouble. There are plenty of well-designed flexible couplings on the market today that are not too expensive.

Proper-sized flush set screws are cheap and easily found. There should be no excuse for using extended bolts in their place because extended bolts are very dangerous. Also they tend to unbalance the shaft.

No motor ever burns out without a good cause and one of these causes could easily be a rigid coupling. While no coupling should be connected to shafts out of line, misalignment may come about through normal wear or other conditions.

That is why a good flexible coupling should be used and never a rigid one.

A CANNON *Laurence Harbor, N. J.*

O Yeah? Watch That Packing

TO MR. YARBROW: I'm one of those off-the-street monkeys who holds down an operator's job in a power plant without a license.

My concern over packing is this: We have an inlet duct and an outlet duct. The inlet cools water for the condensers on our two 15,000-kw turbo generators.

In the summer months the outlet water is too hot to use for cooling water on air ejectors, compressors, generators and water cooled bearings. So we have to use the inlet duct water as it is some 20 F cooler.

To do this, we have to lift the water about sixteen feet with a centrifugal pump. We have five pumps. If my pump packings were not properly lubricated with water it would be impossible to lift this cooler water for cooling purposes. I think *all* packing should be inspected frequently and never be allowed to wear out.

L E WILLIAMS *Indianapolis, Ind.*

Marmaduke's Mailbox

I sure enjoyed my last *Power* issue, especially because I saw it in the works during my visit to your office. Surfaceblow's story was good as usual, but didn't the author jeopardize his next raise when he said "Phil Swain's voice sounded like a croak"?

AL JETER, *Editor* *Hartford, Conn.*
The Locomotive

What raise? PHIL SWAIN

When Marmaduke Surfaceblow told that story in Aug, 1949 *OE* about Reducing, I checked the air system in our plant. And by golley, his advice helped solve part of our problem. I look forward to his stories each month and read it first thing. Hope he keeps at it.

NORMAN E WHITE *Manchaug, Mass.*

I very much enjoy the Marmaduke Surfaceblow stories. It is a clever way to put over a point. I'm not surprised that it has met with so much success.

R D WASSERMAN, *President*
Eutectic Welding Alloys Corp.
Flushing, N. Y.

Any book without an occasional chuckle is pretty dry reading. Even my son, who is in pre-medical school, reads Marmaduke.

ROY A WALLWORK
Grosse Point Woods, Mich.

In checking over all my back numbers of POWER and *OE*, I notice I haven't missed one of Marmaduke's 44 stories. Give my regards to Mr. Surfaceblow. There are so few of his kind of old timer steam engineer left.

DEAN E WRIGHT *Woodbourne, N. Y.*

I note that Marmaduke Surfaceblow sports a double chin from overwork. But certain it is that his liberal chinwagging hits the exact spot in print. There is good profit to be gleaned from his chatter.

BERT RICHARDS *Toronto, Ont.*

We at National Aluminate Corp. found Marmaduke's story, "Voodoo Engineer Marmaduke" very entertaining. And we were naturally pleased with the Old Boy's closing remarks—"Use a good boiler compound and put a real engineer in charge."

L W MENDENHALL *Chicago, Ill.*

I get a buzz out of reading Marmaduke. Every time I pick up *Power*, I somehow seem to remember that Marmaduke is inside. And invariably I find myself looking for his story, first thing.

JOHN E HYLER *Peoria, Ill.*

Even my five-year-old son gets a big kick out of those Marmaduke stories.

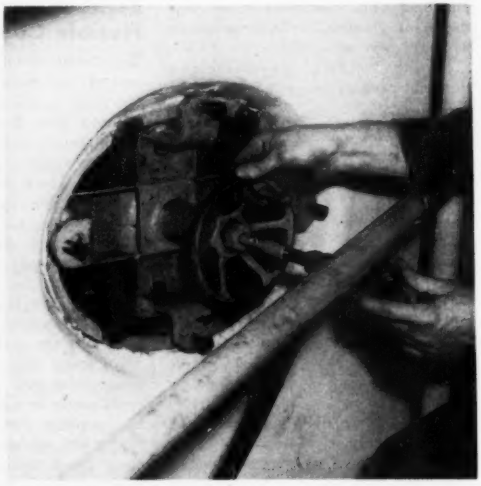
W E CAREY *Detroit, Mich.*

EDITOR'S NOTE: *We don't know how to take this.*

HOW TO LEAK-PROOF MANHOLES

By C B COTTON, *Harbor Steam Plant, Wilmington, Calif.*

GRINDING RIG is light enough to be carried to job and set up by Machinist Claude B Cotton, designer and builder. High-speed, lightweight air motor drives grinding wheel, attached to revolving arm. Only simple air hookup is needed here



PLACE IN MANHOLE and tighten radial setscrews against hole's circumference. Handwheel turns grinder assembly inside. Four screws against manhole rim line up grinding wheel inside so it touches at least three high points of the joint

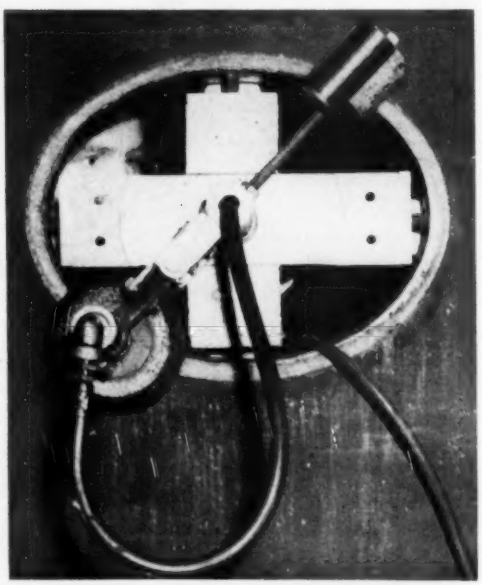
► BOILER STEAM DRUMS warp out of shape with time. Finally, manhole joints give trouble. I solved that problem by building the grinding rig shown.

This device is a simple means of accurately supporting a high-speed motor-driven grinding wheel so the grinding-wheel assembly can rotate about the manhole axis.

Grinder is fastened into manhole with setscrews against the hole's circumference. After wheel is positioned so it touches all around, the air is turned on to air motor. Then grinding wheel is brought into contact with inner-ring surface by four setscrews.

Wheel's friction rotates the motor, wheel and counterbalance. Adjustment is made for wheel and grinding wear with four screws during operation.

Set-up time for machine is 15 minutes or less, and operator does not have to enter the drum. We trued up many manholes with this device at Harbor Steam Plant. And every one is entirely leakproof. Old method took three times as long—didn't do good job. But that's a thing of the past.



TRUED UP and ready for action. Counterweight is screwed into grinder arm from outside so wheel and motor balance. Then wheel's friction rotates assembly without help from operator. (Extension cable through manhole is photographer's)

It's easier to maintain ARMSTRONG TRAPS

THEY SELDOM NEED ATTENTION

GOOD preventive maintenance of course calls for periodic steam trap inspection. To look inside an Armstrong trap you simply remove the cap and lift out the entire mechanism, which is connected to it. The body full of boiling water remains in the line and need not be handled.

Only rarely does inspection reveal the need for cleaning or repairing an Armstrong trap. The swirling action of the condensate during discharge continuously scrubs the trap clean. The hardened chrome steel valve and seat stay steam-tight for a long, long time without attention. There is no wire drawing. The leverage system is almost completely friction-free, will operate hundreds of thousands of times without wearing out.

For trouble-free trap performance there is nothing to compare with an Armstrong. Your local Armstrong representative can help you select the right size traps for your requirements. Call him.

ARMSTRONG MACHINE WORKS
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Armstrong traps on low pressure heating systems require far less maintenance than previous traps...*John Deere Harvester Works, East Moline, Illinois.*

"4 to 5 years service without replacement parts is average on traps draining driers. Some traps in service with no parts for 7 or 8 years—and one for 15 years!"—*Weymouth Art Leather Co., South Braintree, Massachusetts.*

THE ARMSTRONG SERVICE GUIDE explains trap maintenance and repair, contains useful trouble shooting tips. Send for your free copy.

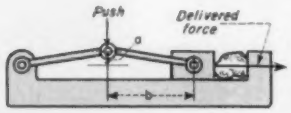
SEE OUR CATALOG IN SWEET'S or ERC

ARMSTRONG STEAM TRAPS

HEADWORK

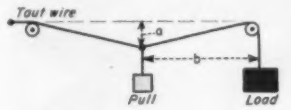
PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

Force Multipliers—2



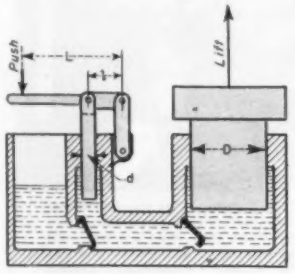
TOGGLE

Multiplication factor keeps increasing as toggle position approaches straight line. For any given position the factor is $b \div 2a$. Thus, if b is 10 in., and offset a is 1 in., multiplication factor is $10 \div 2 = 5$



TAUT WIRE

Taut wire is toggle in reverse. Here again, multiplication factor is $b \div 2a$. The tighter the wire, or rope, or chain, the greater the load that can be lifted by "bowstringing" it



HYDRAULIC JACK

Here, multiplication is proportional to number of times cross-sectional area of small plunger goes into that of big plunger. To get same result quicker, divide D by d, then square. Thus, if D is 5, and d is 1 in., $D \div d = 5$. This squared is 25, so lift is 25 times force on small plunger. In sketch, force is further increased by leverage of handle, $L \div l$. In problem just worked if L were 3 times l, total multiplication factor would be $3 \times 25 = 75$.

LAST MONTH I pictured seven common force multipliers—lever, pulley, spur gear, worm and gear, inclined plane, screw jack, wedge. Here are five more: In each case the caption of the sketch gives the force-multiplication factor. If this factor is 5 (for example) the output force or load will be 5 times the input force—not allowing for friction.

The importance of friction varies greatly from one kind of rig to another. Friction would likely be high for a cam without a roller follower, but most of the other devices shown would probably waste less than 25% of the applied force in friction under average conditions.

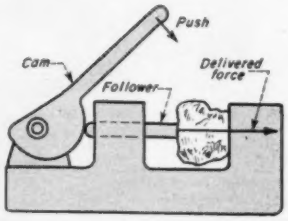
It's worth remembering that force-multiplying devices can be divided into two main classes: (1) those that maintain a constant multiplication factor and (2) those in which the factor changes.

Class 1 includes lever, pulley, gear, inclined plane, wedge, screw jack, hydraulic jack, block and fall. For any gadget of this class, just figure how many inches the applied force must move to move the load one inch. That number will be the force-multiplication factor.

Class 2 includes the toggle, the taut wire and the cam. Here the method just described won't give a dependable value of the multiplication factor, because the factor keeps changing as the device moves. An exact answer requires a bit of math, but you can find the approximate factor on the drawing board.

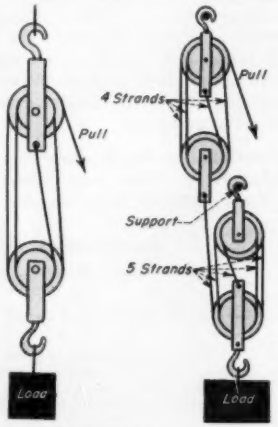
Just draw the device to scale in the desired position. Then redraw it, moved slightly. Scale off the movement of the output end and of the input end. Divide the input movement by the output movement to get the approximate force-multiplication factor.

The smaller the movement, the more exact the method will be up to the point where the movements are too small to measure accurately.



CAM

Cams can be designed to produce any desired pattern of movement. So multiplication factor can change in any desired way. To figure factor for a given position, put cam in that position, and give handle a small movement. By test (or by sketch on drawing board) see how much handle must be moved to give jaw a small movement (say ⅛ inch). Then multiplication factor is movement of handle divided by movement of jaw



BLOCK AND FALL

For a single pair (left sketch) multiplication factor equals number of strands of rope running to the block that carries the load. Here, number is 4. In sketch at right, factor for upper block and fall is 4, that for lower is 5, that of combination is $4 \times 5 = 20$

Tube plates of AnacondA Muntz Metal equip this 50,000 sq. ft. Rectangular Surface Condenser, one of three built by Ingersoll-Rand for the Contra-Costa plant of California's Pacific Gas & Electric Co.

27 tons of ANACONDA tube plates serve P.G.& E.'s three Contra-Costa units

The three new 100,000 kw turbine-generator units of the Pacific Gas & Electric Company's Contra-Costa plant at Antioch, California, will be served by three of these Rectangular Surface Condensers, each containing 50,000 sq. ft. of condensing surface, built by the Ingersoll-Rand Co., New York. Twelve ANACONDA Muntz Metal Tube Plates, each 9'-1" x 9'-1" x 1½" and weighing a total of 54,480 lb., have been built into these three condensers.

This source of additional power for the Pacific Gas & Electric Company system adds another important installation to the impressive list of America's utility and industrial power plants served by ANACONDA Tube Plates and Condenser and Heat Exchanger Tubes. Anaconda's experience in the production of tube plates and tubes and in the selection of alloys for specific operating conditions is freely available to you and to your engineers on any problem involving heat transfer materials. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

for efficient heat transfer

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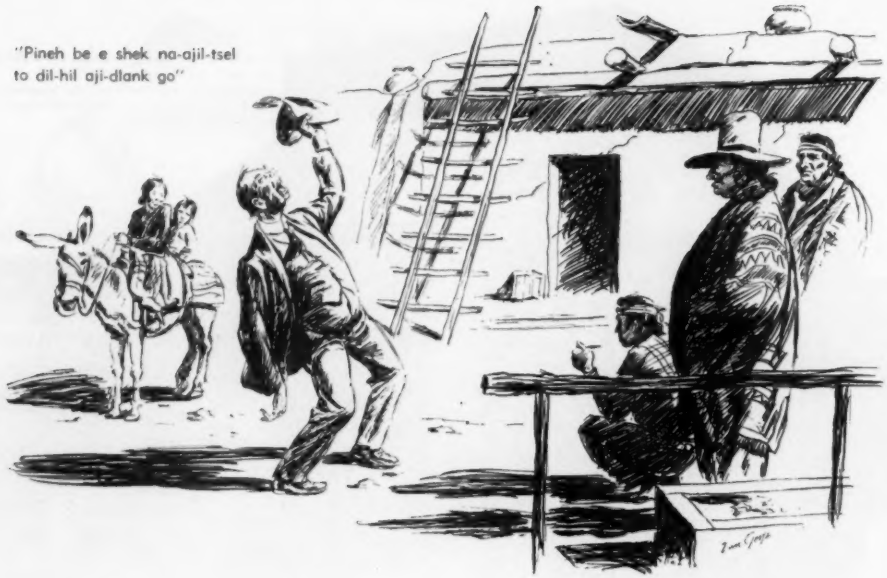


Paleface Gets Heap Big Name

► WHENEVER MY DESK GETS BURIED under a pile of printer's galleys to proofread, illustrations to correct, letters to answer, and the deadline dogs snarl at my heels until things got foggy, I fall back on an old sea-going dodge. I just say, "To hell with it all," and go "topside" for a blow.

My first stop is at Theodore Van Gorp's drawing table in the illustration department. Besides doing the various color covers for some of our 32 magazines, Van knocks out the sketches for Marmaduke's bilgewater. This artist's creative imagination always gives me a lift. But like all true artists, he's a perfectionist and stickler for details.

If Marmaduke sounds off about Navaho Indians, as in this story for example, the adobe huts, clothing, local scenery and every other detail must be firmly etched in Van's mind before he starts. And he does that by burning midnight oil in research.

"Let's grab a bite at the Bent Propeller," said Van, looking up from his work this morning. "I feel like having Marmaduke blast a few cobwebs from my crow's-nest, too."

In the general confusion at the Bent Propeller, we found Marmaduke moored to his end of the fueling pier, calmly reading the June POWER. We glanced around his shoulder and saw it was the "Boiler Inspector's Diary" that held his interest. His reading specs were glued to the page so tightly that he had even released his grasp on his bottle of Sandpaper Gin.

About the time Van and I sat down to a table, Marmaduke slammed that fat 350-page POWER issue on the bar and roared, "BILGEWATER ON ENGINEERS WHO TRY TO CHANGE A BAD REPUTATION. IN THIS GAME YOUR BEST BET IS NEVER TO GET ONE."

"I don't know what he's raving about, but there goes my headache," said Van, wetting his whistle with a scuttle of suds. "Mine too," I answered, doing likewise.

Waterfront characters, ships' engineers and maintenance men, and customers from a nearby packing house all turned toward Marmaduke. We knew this ancient steam engineer, boiler maker, machinist, steam fitter, or what have you. And we knew he had something important to say.

Marmaduke raised a high vacuum on his bottle of Sandpaper Gin and filled his gravity tank right up to his overflow pipe. Then he shut down his pump and faced his audience.

"Back in 1901, I signed off the West Coast lumber schooner *SS Alva Ross* and headed for Leaning Horse, New Mexico," barked Marmaduke. "My old shipmate George Gleason was chief at the Leaning Horse Power Co's plant. He offered me the steamfitter's job.

"One fireman there was Otis Travis, known as a local character by the natives. I wasn't on the job two hours before I learned the Navaho Indians around there called him 'Pineh be e shek no-ajil-tsel to dil-hil aji-dlank go.'

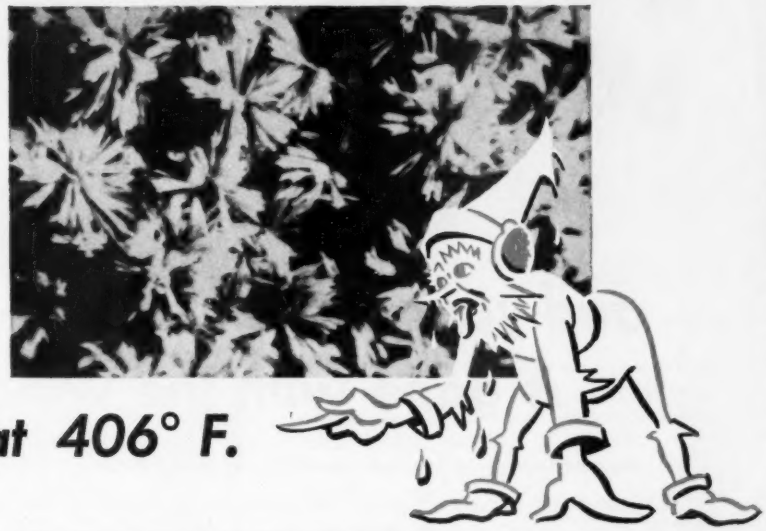
"'What does that fancy handle stand for?' I asked Travis a few days later, after I learned my way around. He had a smirk on his puss as he explained. 'He breaks his kettle when he drinks firewater.'

"I soon found out how he got it. Years before, Travis came to Leaning Horse and got hitched to an Indian girl. But his Indian in-laws didn't take to this paleface. Finally a papoose came along, then another, and still another until they added up to nine.

"What with not being accepted by

(*Continued on page* 208)

JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

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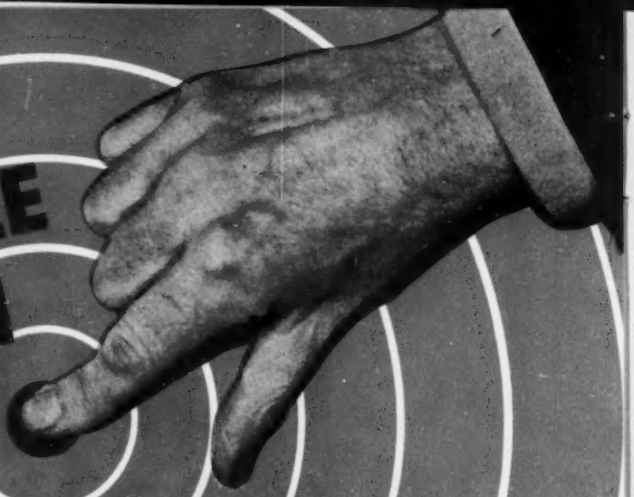

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Easy Operation—Press the button on the Automatic Sequence Head, and the System opens and closes dust valves, skips boilers that are off the line, warns of unusual conditions, and shuts itself off when all the dust has been removed. Can be operated by inexperienced men without difficulty.

Low Maintenance—Perfect timing insures that the air is always properly loaded with dust. Thus wear on the system from "sand-blasting" is eliminated.

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The Automatic Sequence Head—the "brain" that directs the highly efficient Hydrovac Dust System.

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materials handling systems

Where Power and Heat protect the helpless...

Buffalo State Hospital relies on Jenkins Valves

Architects: YORK & SAWYER, NEW YORK
General Contractor: THE JOHN W. COWPER CO., INC., BUFFALO, N. Y.
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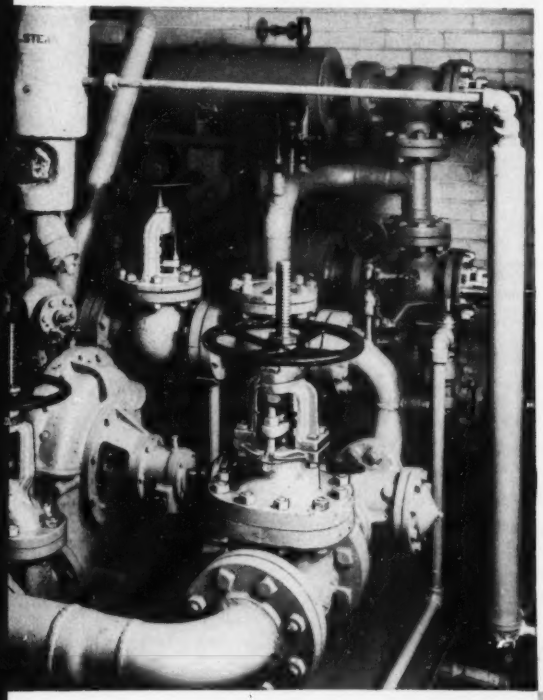

Among the 1100 Jenkins Valves in the new Power House at the Buffalo, N. Y., State Hospital are these in the prefabricated pump heater set. More than 875 others control steam, water, fire, air conditioning and other vital pipelines in the new Medical and Surgical Building.

Serving a veritable "city of patients", the new power plant at this New York State Institution, one of the nation's largest, provides heat and power for many separate buildings. One building alone, the newly-completed Medical and Surgical unit, has 698 rooms.

In such a complex modern "plant" for the treatment and comfort of patients, power and heat must be supplied with unfaltering *efficiency.* On their performance record, Jenkins Valves were chosen.

This same efficiency is essential to operating *economy,* present and future, in *all* buildings served by power installations. That's why Jenkins Valves have been the choice, consistently, for so many of the notable new plants and buildings arising throughout the nation.

Jenkins builds *extra* endurance into valves — proved by low upkeep cost records in power plants both large and small. Yet, despite this *extra* value, *you pay no more* for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17. Jenkins Bros., Ltd., Montreal.

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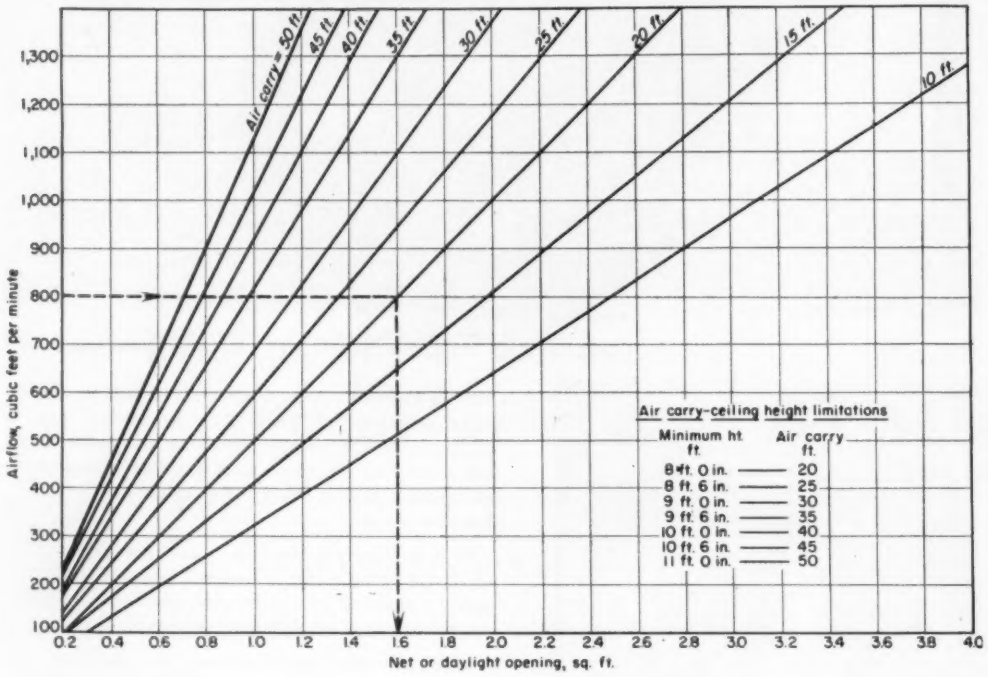
JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

POWER'S DATA SHEET

NUMBER 231



Air-Supply Grille Sizes

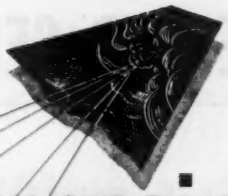
► MOST HEATING, ventilating and air-conditioning systems use many openings of various dimensions. These must deliver different amounts of air flow and produce given penetrations or air carry into the rooms. To minimize slide-rule work involved in this sort of job and increase accuracy of design calculations, we have found the above chart very helpful.

Size, shape, location and occupancy of room determines the air flow needed and the air carry. Air carry-ceiling height relations are given in the table on the chart.

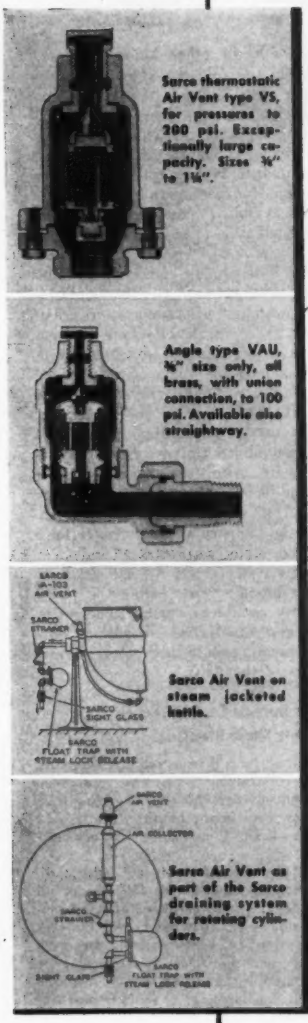
Find the required air flow, say 800 cfm, on the vertical scale. Follow horizontally to the right to needed air carry, say 20 ft, and drop vertically to horizontal scale to find answer of 1.6 sq ft net opening.

Manufacturers' data give this net area in percent of gross duct dimensions. Ratio of grille width to height has no appreciable effect on distance of air carry. In large rooms air carry must be studied critically to insure good distribution of air flow.

J D CONSTANCE *Cliffside Park, N. J.*



air is expensive in the wrong place



Sarco thermostatic Air Vent type VS, for pressures to 200 psi. Exceptionally large capacity. Sizes ¾" to 1¼".

Angle type VAU, ¾" size only, all brass, with union connection, to 100 psi. Available also straightway.

Sarco Air Vent on steam jacketed kettle.

Sarco Air Vent as part of the Sarco draining system for rotating cylinders.

Air is to be found everywhere – indoors, outdoors, above and below. It's difficult to think of it as expensive – it's so plentiful!

But air is to be found also in the steam spaces of your steam heated equipment. The air dissolved in the feed water supplied to your boilers finds its way into the heaters with the steam.

This air *is* expensive – because it reduces the temperature of the steam, and coats the heating surfaces with a film which retards heat transfer, lowers output, and increases losses.

Remove expensive air from your steam heated machines with SARCO THERMOSTATIC AIR VENTS, scientifically designed for this express purpose.

Write for BULLETIN 2751 and the name of the Sarco man nearest you. He will be glad to help you select the best type of vent for your purpose, and the right place to install it for best results.

SARCO ELIMINATES AIR

333

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READER SERVICE SECTION

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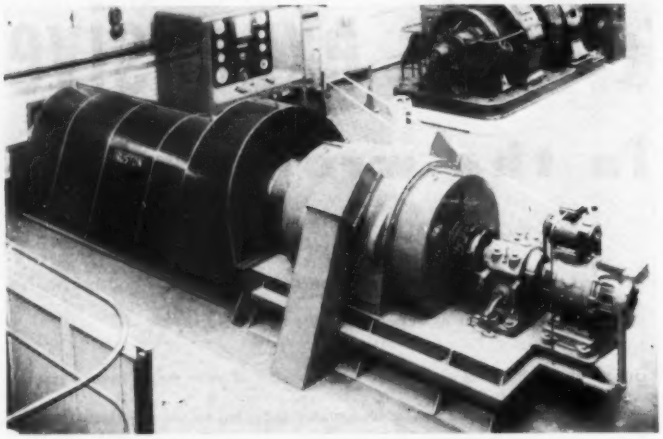
TECHNICAL BRIEFS 150
PLANT EQUIPMENT NEWS 154
NEW FREE BULLETINS 163



British Festival Features Gas Turbines

Britain has gone all out for the gas turbine, judging from the emphasis it has received at the Festival of Britain. An indication of the progress the British are making is the test results on the 750-kw gas turbine, above. For more details on their progress turn to the special report to *Power* appearing on p 216.

Atomic-Power Future Good

► IF THE PROSPECT of atomic power as a source for generating electric energy ever becomes a commercial reality, the power systems of the country—both public and privately owned—could be the largest potential users of nuclear reactors, just as they are today the largest users of fuel-fired steam boilers.

This statement in the recent report of the Ad Hoc Advisory Committee on cooperation between the electric-power industry and the Atomic Energy Commission pinpointed the obvious interest the power industry has in harnessing atomic power. This special committee, consisting of Philip Sporn, chairman (president of American Gas & Electric Co), E W Morehouse (president of General Electric Public Utilities Corp), Walton Seymour, adviser on power problems to the Economic Cooperation Administration, was set up by the AEC to seek out a workable plan for electric-power industry cooperation with the AEC.

The committee was given free access to secret as well as nonsecret information to aid them in arriving at an answer. Most of the major research installations were visited and frequent conferences were scheduled with the AEC staff and its contractors.

In the opinion of the committee "whether and when atomic power becomes commercially feasible depends on the AEC's nuclear reactor program." This program, the committee points out, is still in the research and pilot-plant stage except for the piles producing plutonium for bombs.

The fact that the possibility of commercially feasible heat energy from nuclear reactors cannot be realized for some years to come ought not to weaken its attraction to the electric industry, in the opinion of the committee.

As an indication of the degree of interest in atomic energy, the committee included in its report the following quote of an unidentified AEC member: "If the intriguing possibility of nuclear breeding can be made a reality, it may very well give us a reduction of cost of atomic power to where it can compete with all other known sources."

As to the role the electric industry can or should play in the development of nuclear reactors, the committee had some definite suggestions. Because the electric-power industry does not have the opportunity to participate directly through contract operation, as do the chemical and equipment manufacturers, its contribution must be along different lines.

For a beginning the industry must place primary emphasis on increasing its knowledge of atomic energy. Actually, there are definite steps that can be taken to attain this objective. Prominent among the suggestions are: (1) The industry should take advantage of the AEC Oak Ridge School of Reactor Technology, POWER, May 1951, p 208, where qualified trainees from industry can secure a substantial background in reactor technology and allied subjects. (2) AEC should employ technicians from the industry on a temporary basis for the study of coolants and heat-transfer systems. (3) An industry committee broadly representing the power industry should be set up so its members can familiarize themselves with the reactor program and other relevant phases of the AEC.

Mines Bureau Contracts For New Shale Plant

Contract for a demonstration-scale retort, which will employ a new and very promising process developed for continuous extraction of oil from oil shale, recently went to Blaw-Knox Construction Co of Pittsburgh, Pa.

The new demonstration unit, with a capacity range from 150 to 400 tons of oil shale daily, will be patterned after a 6-ton-a-day pilot plant that has proved the new "gas-combustion" process both the most efficient and the most economical ever tested at Rifle, according to Boyd Guthrie, chief of the Bureau's Oil-Shale Demonstration Plant.

"If the new retort operates as antici-

(*Continued on page* 214)

FOR MORE NEWS . . .

. . . of the power field, see the items on page 214. Also, the Coming Events for this issue appear on page 216. Appointments are on page 226.

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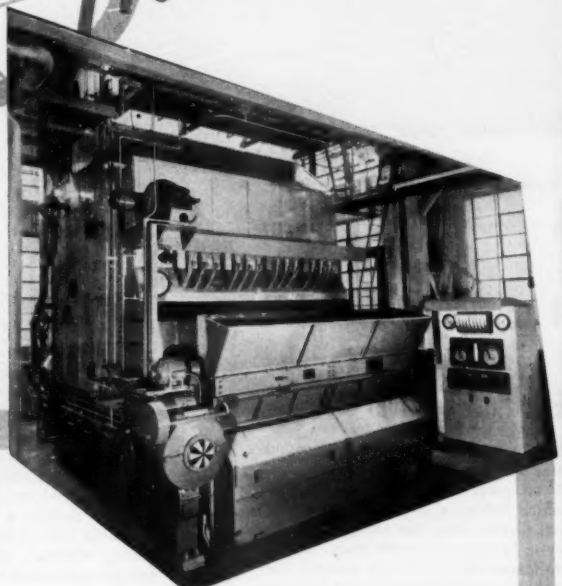

Most recent of six B&W Integral-Furnace Boilers, installed in Falstaff breweries at St. Louis, Omaha and New Orleans.

Local unwashed Illinois coal is $1.10 a ton cheaper than the higher, washed grade formerly required by the Falstaff Breweries' natural draft stokers. When a new B&W Integral-Furnace Boiler, Type FF was installed in their St. Louis plant No. 5, Falstaff enjoyed an initial saving of 25% on fuel costs.

And that wasn't all . . . with the new B&W unit, they squeezed more efficiency from the cheaper fuel by increasing the rate of evaporation from 6.6 pounds of steam per pound of coal to 8.4 pounds . . . bringing fuel savings to a total of 45%!

Sudden load surges typical of brewery requirements are met with ease. Steam loads can be increased 15 to 20% within a matter of seconds without carryover or loss of pressure. Whatever your business, the use of B&W's 80 years' experience in boiler improvement is sure to be appreciated by your plant engineers and cost accountants. The Babcock & Wilcox Co., 85 Liberty St., New York 6, N.Y.

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G-526

TECHNICAL BRIEFS

Latest engineering developments for busy power men

13 digests for you on:
ELECTRICAL CONTROLS
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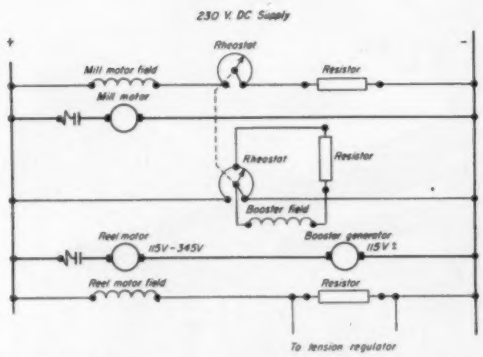
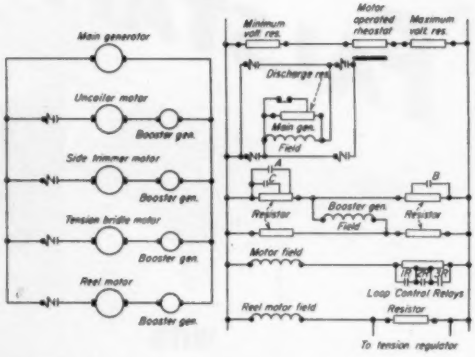


1 Mill-and-reel line for rolling metal strip and winding it has its driving motor operate on voltage from 115-345 v



2 Variable-voltage control for regulating speed of a steel mill's side trimming and recoiling line uses rheostats

Electrical Controls

INFLUENCE OF APPLICATION REQUIREMENTS ON CONTROL DESIGN, *by Keith H Rapsey.* Basic components from which industrial control equipment is put together have not changed in name or in function for many years. Today's designers still work with assorted contactors, controlled-circuit relays, overload devices, timers, pushbuttons and other accessories.

In the early days of electric motor drive the control consisted of an infrequently operated starter of a simple design. Even today the great majority of applications call for plain on-off switching, usually with an inverse-time-limit overload protection feature. Early machines depended on gears, clutches, and a skilled operator for close control. Since that day designers have learned that electrical control-circuit is cheaper, faster, more consistent.

Today's specialized controls call for protection from damage in "unhealthy" locations, longer life at higher operating speeds, groups of inter-related and inter-locked functions, all combining to place on the industrial-control designer a need for positive action and comparatively light maintenance.

The author then describes how certain standardized control components can be put together to meet specifications laid down by the sample users. The chief application described is one made by the Hydro-Electric Power Commission of Ontario.

The author goes on to discuss the need for pilot devices and gives particular emphasis to the subject of timers. He points out that there is a choice of various type timers, such as motor-driven, pneumatic, thermal, electronic, flat-work, dashpot, and flux-decay. *AIEE paper. No number.*

RHEOSTATIC CONTROL OF SHUNT FIELDS, *by C A MacPherson, Canadian Controllers, Ltd, Toronto.* Briefly describes the principal method of shunt-field control for dc motors and generators and a few of their applications. The paper begins with the simplest and most common rheostat connection, that of putting an adjustable resistor in series with a working shunt field.

Then in succession, various potentiometer connections, such as the bridge method, the center-tapped rheostat, are treated and compared.

There follow a number of specific applications, including a 2-motor calender drive as an application of the shunt-field rheostat, a mill-and-reel line, Fig. 1, and a side trimming and recoiling line, Fig. 2 as other working examples.

In each of the applications cited the author gives a detailed analysis of the control equipment and how it functions. In addition certain of the design elements are given.

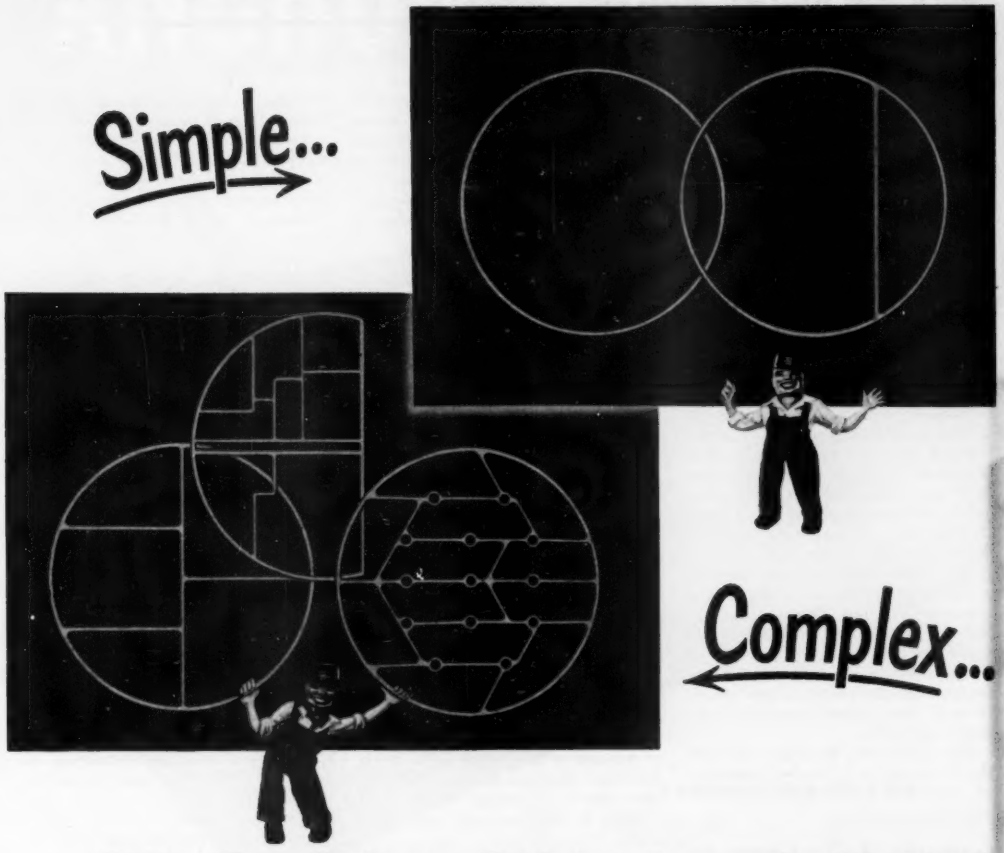
The author mentions that many factors influence the type of field control selected for a particular job. One major consideration is how critical the speed-control needs are and also how close each machine must be kept to that critical speed. Sometimes, it is the nature of process that determines the type of control. Other times, it is the number of machines being used at one time. Size of motor and inertia of machine are other items, as well as range of speed. *AIEE paper. No number.*

TYPE OF FAULT INDICATION CONTROL USED WITH COORDINATED ELECTRIC DRIVES FOR STEEL MILLS, *by R L Houlton, General Electric Co.* Twenty years ago a typical, modern, tandem cold mill had 400-hp motors on each of four stands. These motors worked from a common, constant-potential bus and were started magnetically under rheostatic field control. Tap capacity was under two tons an hour and slightly over 200 fpm. Today, a 5-stand tinplate mill has 17,000 hp in connected motor capacity with 21 armatures in the main power circuit. Each stand and tension reel has its own Ward-Leonard voltage regulator and the first and last stand and reel

Directions for ordering papers are given on page 152

Precision-made to the design you need . . .

Simple...



Complex...

Goetze Heat Exchanger Gaskets stay on the job longer!

Whether your specifications call for a simple or complex design, you can depend on Johns-Manville Goetze heat exchanger gaskets to do the kind of sealing job that costs you less in the long run!

That's because they are carefully hand-tailored to assure the accuracy of fit so important in heat exchanger service. Every detail of construction reflects the craftsmanship that goes into the fabrication of these better gaskets. You'll find no wrinkles or cracks on the corners. Lap widths are ample, rib widths uniform.

More than 60 years of gasket-making experience is your further assurance that when you put a Goetze heat exchanger gasket on the job, you can count on it to *stay* on the job for a long time. For further details and a prompt estimate of cost, send us a blueprint or template. Just address Johns-Manville, Box 290, New York 16, New York.

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Johns-Manville Goetze GASKETS

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE

Begins on page 150

have motor field regulators. Rotating regulators and mill auxiliaries necessitate another 75 machines. Top speeds run above 6000 fpm and production consistently averages above six tons an hour.

The author raises the question of whether fault indicators have kept pace with other control developments. On the 1926-30 magnetic control system where relatively few machines, devices and rheostats were involved, periodic inspection was carried out as a protective-maintenance measure. The search for faults was confined to a relatively small area.

Periodic shutdown for preventive maintenance is still a necessary practice. Quickly locating a fault that causes an accidental shutdown is now much more important than of old and yet less easy to do. At 60-tons-an-hour production, five minutes of down time can cost $2000 in lost production alone.

The author points out that there are a variety of simple and effective fault indicators available. The cost of applying one to a 5-stand cold mill would equal the cost of only a few minutes lost production. The very simplicity of the fault indicators seems to have robbed them of their proper consideration by producing mills.

The author then describes several of these systems and touches somewhat on their application. *AIEE paper. No number.*

COMMUTATING REACTOR CONTROL FOR MECHANICAL RECTIFIERS, *by E J Diebold, I-T-E Circuit Breaker Co.* The mechanical rectifier is a synchronous switching device. It makes a metallic connection between an ac and a dc network. Being a pure switch, it has no interrupting capacity and cannot be used as a circuit breaker. It is also unable to withstand closing under full power, so to use such a switch as a mechanical rectifier without any protection during opening and closing periods will immediately result in its destruction.

During the past 15 years a number of mechanical rectifiers using various protective circuits have been in operation. The authors discuss experience with them in four switching conditions. It seems that these conditions are a serviceable guide for a good mechanical rectifier.

Commutating reactors inserted in series with the switching contacts help satisfy the switching conditions at all possible loads, voltages and frequencies because the reactor circuits have nonlinear circuit elements to maintain the inrush current after closing and the residual current before opening at a very low value. This permits the free flow of current through the contact at any other time of the cycle.

Without adequate control, the best available commutating reactors do not satisfy the most rigorous switching conditions. There are, however, several known methods to control reactor operations. The authors supply several schematic diagrams for simple control circuits to illustrate their point. *AIEE paper No. 51-211.*

SOME BRITISH ELECTRONIC POWER CONVERTERS, *by J E Boul, English Electric Co, Ltd.* Between 1930 and 1940, American and British practice in electronic power converters began to take different paths. In the U.S. Ludwig & Slepian were developing the ignitron. In England, attention was focused on further refinements of the multi-anode rectifier.

This paper describes typical multi-anode, air-cooled, sealed, steel tank rectifiers and rectifier circuits for industrial transportation, electrochemical and high-voltage supplies up to 15,000 v. Account is also given of a newly developed single-anode air-cooled rectifier tube for an output of 260 kw at 12,000-v dc, with particular application to radio broadcasting transmitters and industrial radio frequency heaters.

Author discusses the following features of electronic power converters: rectifier construction, auxiliaries, auxiliary protection, multi-tank equipment, protection, control of dc motors. *AIEE paper No. 51-209.*

ELECTRIC SHOCK, *by Wills McLachlan.* Discusses the problems of handling electrical shock and gives an excellent series of references to literature in several languages.

Conclusions state that severe electrical shocks can be received from very low potentials, and wet contacts must be assumed in the actual cases. Passage of electrical current through a body produces a nerve stimulation that carries back to the nerve centers and on breaking may produce a paralysis of these centers and possibly a block of the nerves. First result is a panic spasm of the muscles, and then relaxation. Breathing stops and the blood tends to leave the upper parts of the body and collects in the large blood vessels of the abdomen. The heart rate is materially affected.

Since there often is a paralysis at the nerve centers after electrical shock, the usual tests for life are not dependable. For instance, the stethoscope is unreliable. Success is much higher in resuscitation where the contact with the energized circuit is of short duration and when artificial respiration is promptly applied. British and American Commissions endorse manual methods in preference to the machine method of artificial respiration. *AIEE paper No. 51-281.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources unless otherwise stated. Order complete paper from source, not from POWER.

American Institute of Electrical Engineers, summer meeting, Royal York Hotel, Toronto, Canada, June 25-29, 1951. Identified by initials AIEE. Obtainable through AIEE, 29 W 39 St, New York 18, N. Y.

American Society of Mechanical Engineers, oil and gas power conference, Baker Hotel, Dallas, Texas, June 25-29, 1951. Identified by initials ASME, OGP. Spring meeting, Atlanta, Ga. April 2-5, 1951. Identified by initials ASME, SA. Annual meeting, Statler Hotel, New York, N. Y., Nov 29-Dec 1, 1950. Identified by initials ASME, A. Obtainable through ASME, 29 W 39th St, New York 18.

Diesels

DIESEL ENGINE CRANKCASE EXPLOSION INVESTIGATION, *by G W Ferguson, The Texas Co.* The occurrence of crankcase explosions has long been a hazard to safe diesel-engine operation. With the tremendous increase in diesel power within the last ten years, there has been a significant increase in the number of these accidents. A project has been initiated to study crankcase explosions and investigate the inflammation properties of various oils employed in diesel-engine lubrication.

A summary of 104 explosions, based on literature and accident reports over the last ten years, serves as a study

(*Continued on page* 188)

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MODERN power-operated machines have created a demand for packings capable of giving service on greater pressures and temperatures than ever encountered. To meet such a need comes Anchor VY/FLEX, a highly specialized packing designed by The Anchor Packing Company to withstand the operating elements where many other packings have failed. VY/FLEX withstands most high pressures and high temperatures . . . is adaptable to a wide variety of uses. Write us today for full details.

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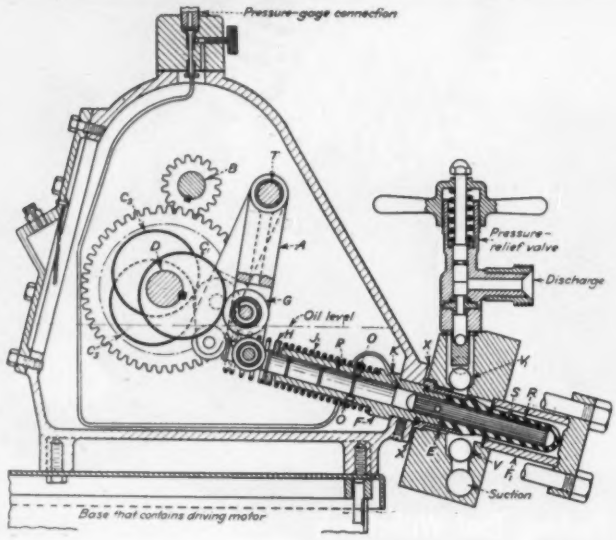

SANITARY PUMP ACTUATED BY BREATHING PULSATOR **P901**

Triplex, sanitary, high-pressure, homogenizer, leakproof pump has operating mechanism separated from the pumped liquid. In the drawing, section to right of *X* is the pump with its ball suction and discharge valves and pressure-relief valve. Driving mechanism, to left of *X*, has a camshaft *D* on which are three cams C_1 C_2 and C_3 that drive actuating pistons *P*. Camshaft *D* gears to shaft *B* driven through a multiple V-belt by a motor in the unit's base. Pistons *P*, their cylinders and part of their operating mechanism are continuously immersed in the actuating fluid, oil.

Pulsator *R*, of synthetic rubber, is bonded to sleeve *E*. A metal support *S* inside the pulsator connects to cylinder *F* inside of which actuating piston *P* operates. This piston has a collar *H* that takes tension of spring *J*.

Arm *A* pivots at *T*. Cam C_1 rides against ball-bearing roller *G* on a stub shaft in *A*. A second ball-bearing roller on *A* contacts the end of piston *P*. In the drawing, cam C_1 has pushed piston *P* to discharge position against tension of spring *J*. When the camshaft makes a half revolution, cam C_1 will have moved 180 deg. This lets piston *P* move to the left and uncover parts *O* to make up any slight oil leakage from cylinder, ready for discharge stroke.

Pressure inside the rubber pulsator is relieved and it contracts onto its support, to create a vacuum inside cylinder F_1. Liquid then flows into the cylinder through ball suction valve *V*. When cam C_1 makes another half revolution arm *A* moves piston *P* to the position shown and drives oil into rubber pulsator *R*. This pulsator expands and forces liquid out of cylinder F_1 through ball discharge valve V_1 and out the discharge.

Because the pumping end of the unit has no rubbing parts it can run dry without damage and is also self-priming. These units can handle sizings, corrosive liquids, dairy products, food, lubricants, paints, vegetable oils, and many other similar products. Built in four sizes from 0.5 to 2.5 gpm, they are for pressures up to 3000 psi, but operated at 6000 psi.

Pioneer Div, Scott & Williams, Inc, Empire State Bldg, New York 11, N. Y.

For more data on these items, use post cards, p163. Identify request with P and number.

And Next Month . . .

Dry-type transformers with Class H insulation for station auxiliaries and unit substations. They're available as ventilated or sealed-in-nitrogen units. You can get the ventilated type in ratings up to 3000 kva and in voltage ratings to 15 kv; Class H sealed-in-nitrogen type made to 2000 kva, 15 kv and below.

MASONRY DRILL **P921**

Carbide-tipped masonry drill bit, called the *Cyclo-Core*, with a removable *Cyclo-Center*, allows precision drilling in concrete, glazed tile or other materials needing a rotary-type drill, with pressure applied for holes ¾ in. dia and up. Removable center does away with the need of a wood template to start holes. A machined spiral thread running the full length of the body carries out all dust removed by the drill bit.

New England Carbide Tool Co, Cambridge 39, Mass.

FORCED-DRAFT FAN **P904**

Large, deep-inlet cones, streamlined to reduce inlet turbulence; open space between wheels instead of a common center disk on double-wheel models permits 4-way diffusion of air. Oversize housing to further assist diffusion make up the principal improved features of the company's new forced-draft fan. These features are said to provide a more complete conversion of velocity pressure to static and improve fan efficiency. Precisely shaped backward-curved blades offer a more nearly perfect aerodynamic flow across leading and trailing surfaces, according to the maker.

Prat-Daniel Corp, East Port Chester, Conn.

FLOOR FINISH **P905**

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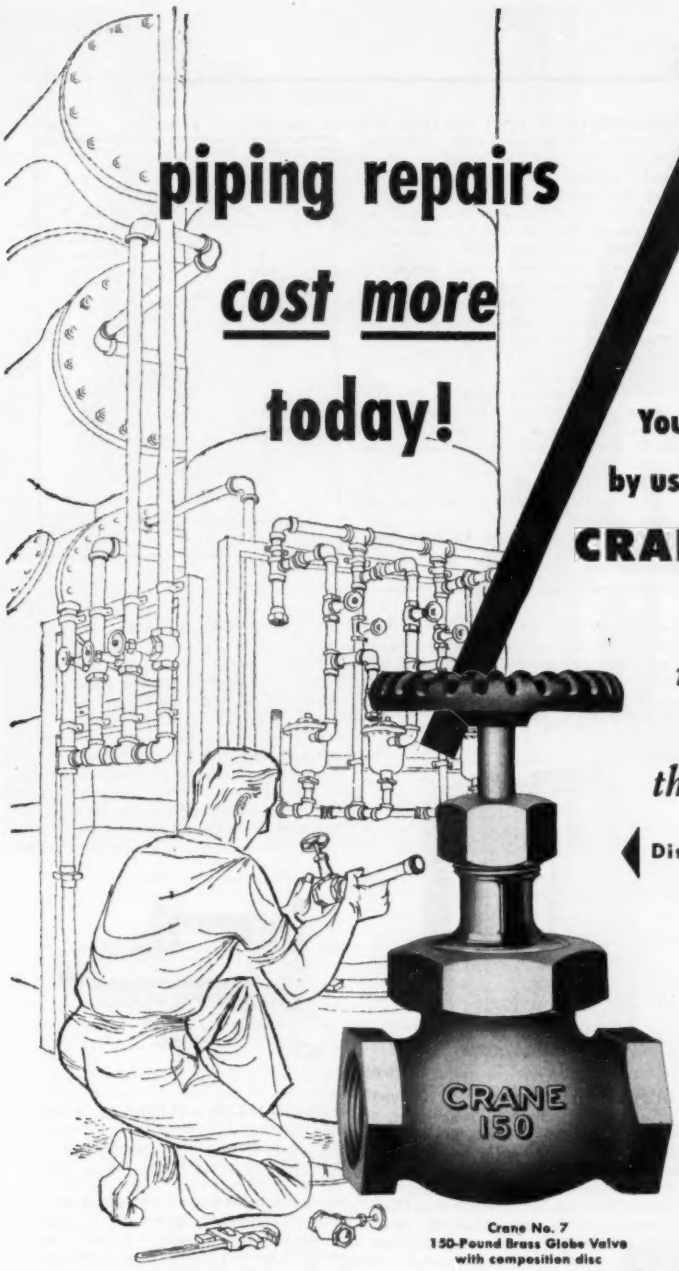
General Flour Co, 110 E 42nd St, New York 17, N. Y.

COAL THAWER **P940**

Portable coal-thawing tube operates with compressed air from 40 to 120 psi as atomizing medium for oil entering the burner equipment. The burners, venturi suction

piping repairs *cost more* today!



Crane No. 7
150-Pound Brass Globe Valve
with composition disc

You spend less
by using Dependable Quality

CRANE VALVES

. . . That's why more Crane Valves are used than any other make

Disc repairs made in a minute

You save maintenance time and money when you use Crane No. 7 Brass Valves with composition disc. When a leak shows up, you don't change valves . . . just open the bonnet joint and slip on a spare disc holder with a new disc already in it.

And by changing the type of disc, you can adapt No. 7 valves to a wide range of services—steam, hot water, cold water, air, oil, gas, and gasoline. Made in globes and angles; screwed or flanged ends.

Simplified maintenance and complete adaptability to your service typify Crane Quality valves and fittings for every need. That's why they cost less in the long run.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 154

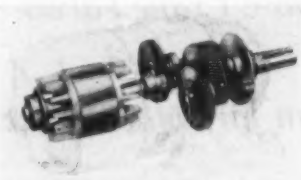
type, are placed the length of the thawing tube. These thawing tubes are set on runners 7 ft 3 in. long, 13 in. high and 10½ wide, and are fitted with a heavy-steel pulling eye. Each burner has a capacity of 18 cfm and a range of burning from 1½ to 6 gal per hr of kerosene or distillate-fuel oil.

Hauck Mfg Co, 124-136 Tenth St, Brooklyn 15, N. Y.

HAND WRENCH P943

One wrench with 64 socket sizes can do the work, its manufacturer claims, of an open-end wrench, crescent, box, socket, ratchet and crowfoot wrenches. It can be used with a torque handle for torque rated fittings with sockets from ⅜ to 4-in. size The TAC open-end ratchet wrench is said to be readily fitted in hard-to-get-at places because of its open-end construction.

Tubing Appliance Co, c/o B H Brown & Staff, 3719 Wilshire Blvd, Los Angeles 5, Calif.



GEARMOTOR P948

By using two secondary pinions to drive the output gear, the effective torque rating is double that of a conventional single pinion and gear unit. Splined herringbone pinion equally divides load between the two secondary pinions.

Available with ratings of 5- to 25-hp, and with speeds from 30-to-84-rpm, the Type GL has asbestos-protected windings.

U.S. Electrical Motors, Inc, 200 East Slauson Ave, Los Angeles 54, Calif.

ELECTRICAL TAPE P944

Tape made with *Koroseal* material. Adhesive is nontransferring and can be pressed repeatedly onto a dry surface without losing its stickiness. It will not transfer the adhesive from the face, lose its tackiness, or ability to adhere. Tape sticks snugly and securely to itself and insulation around copper wire.

Tape has a dielectric strength of 8000 volts, is waterproof, highly abrasion-resistant and flameproof, resistant to acids, oil alkalies and corrosive salts. It is extra thin, hence takes up less room in junction boxes and other tight quarters. Packed in a roll 60 ft long, the tape is ¾ in. wide and .007 inches thick.

B F Goodrich, Akron, Ohio

For more data on these items, use post cards, p163. Identify request with P and number.

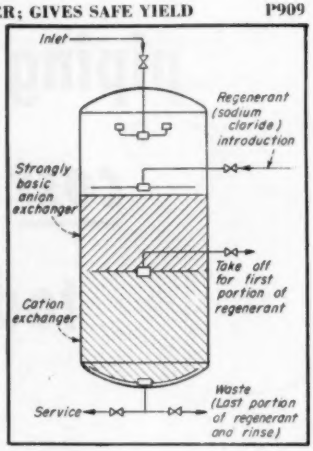
ION-EXCHANGE UNIT SOFTENS WATER; GIVES SAFE YIELD P909

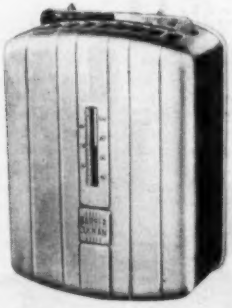
Simple, inexpensive water softening, without the need for handling caustic soda, sulfuric and hydrochloric acid during the regeneration process, can be had with the new Dual Bed ion exchanger. An installation basically has a single tank.

Water yield from the dual-bed exchanger is described as safe because it cannot produce an acid water during the treating step or acid-waste during regeneration. It employs new-type resins that are regenerated with plain salt. In addition to softening water the new resins remove alkalinity and sulfates.

In most industrial applications this unit serves two purposes: (1) simple, inexpensive removal of the "hard" chemical salts producing calcium and magnesium scales (2) removal of alkalinity, which forms carbon dioxide in the boiler and corrosive carbonic acid in condensate return lines.

Permutit Co, 330 West 42nd St, New York 18, N. Y.





DUPLEX THERMOSTAT P903

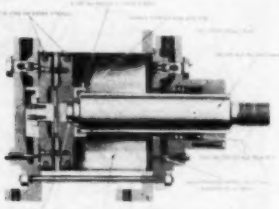
Two-position control of motor-operated valves, relays, pumps and other heating-system components can be had with the new low-voltage, duplex thermostat. This device changes from one thermostatic element to the other by automatic time clock or manual switch. Stops inside the champagne-gold-finished metal case permit setting limits or lock controls.

Barber-Colman Co, Rockford, Ill.

WIND RECORDER P942

Rugged recorder houses a wind-velocity recorder of a dual-range design. Range 1 covers from 0 to 50 mph, and range 2 from 5 to 200 mph. Velocity indications are made by a pen moving across a logarithmic scale. Instrument is furnished for use with either a directional or a horizontal non-directional probe. The probes are temperature compensated. Accuracy and calibration of meter are not affected by the length of lead-in from the probe to the recording instrument, nor by ageing or exposure of that probe. Device is suitable for applications, such as air pollution research, the testing of heat and ventilation systems.

Hastings Instrument Co, Super Highway and Pine Ave, Hampton, 10, Va.



LOW-PRESSURE CYLINDER P928

Low-pressure cylinder with cork floater-rings to facilitate cushion alignment with the head and assure a seal during cushioning has spring-backed chevron rod packing that is self-adjusting for correct compression. Cylinder; known as LT, runs by air, oil, or water, and is designed for operation up to 110 psi. It can work on higher pressure depending on cylinder diameter and the medium—air, oil or water.

Hanna Engineering Works, 1765 N. Elston, Chicago, Ill.

PEDESTAL PRESS P934

Portable, compact with a 20x21-in. base, this pedestal press can be used with the manufacturer's hydraulic puller. The press

Condenser Tubes must be... KEPT CLEAN

Newport shoots the brushes through the tubes with an air-water gun at 75 lbs. per sq. in. They come from the far end like projectiles. Another Revere contribution was to assist in the design of a target to stop the brushes without damage.

● Condenser tubes almost immediately acquire a film that protects the metal from corrosion. Such film is thin, and beneficial. If it does not form, the probability is that the wrong alloy has been selected. It is part of Revere's service to collaborate with you in selecting the alloy that will be most economical in the long run.

There is another and much heavier type of formation within a tube that impairs its operation, or shortens its life, or both. This is the deposition of foreign matter such as shells, which may cause erosion-corrosion effects, and the growth of organisms such as algae. The latter materially reduce heat transfer.

Take the case of the Newport Electric Corporation, Newport, R.I. Its condensers are cooled by harbor water, with the result that algae and other marine organisms coat the tubes, reducing efficiency, lowering the vacuum, and increasing fuel consumption.

This utility is exceptionally well managed, with a systematic tube-cleaning program. However, it found that brushes and rubber plugs used for cleaning wore out quickly. Revere took a close interest in this problem. One of Revere's customers makes nylon brushes for cleaning tubes in dairies, and it was suggested that a modification of these be tried. Results: over 300 tubes cleaned per brush, a much longer life than anything previously used, and a half-inch gain in vacuum, meaning dollars and cents saved in fuel.

Revere makes condenser tubes and plates in all the usual alloys, and is glad to collaborate not only in specification, but in other condenser problems, as this case history shows. We are only too glad to work with you on any matter involving condenser and heat exchanger operation. Our wide experience, and contacts with many industries will be made freely available to you. Write the nearest Revere office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

More EQUIPMENT NEWS

Begins on page 154

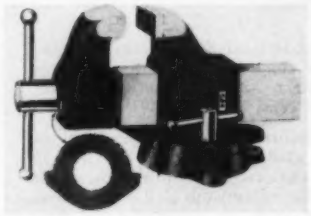
has a strong open throat plate, which permits unlimited vertical adjustment for handling wheels, pulleys, bushings, couplings, gears, bearings under operation with the company's *Power-Twin* 17½-ton ram hydraulic puller.

Owatonna Tool Co, 378 Cedar St, Owatonna, Minn.

MAINTENANCE TOOL P912

Heavy-duty, universal, electric *Impactool*. Size 34 U has a 1-in. square drive and is rated for bolts up to 1 ¼-in. The device converts the power of an electric motor to hundreds of rotary impacts, which can quickly run nuts up tight or remove the most stubborn or rusted ones. It measures 10⅞ in. high, 4¾ in. wide and 14⅛ in. long, excluding the adjustable grip handle, which can be attached in any one of three positions or removed entirely. The other handle with a trigger switch may also be rotated 180 deg.

Ingersoll-Rand Co, Phillipsburg, N. J.

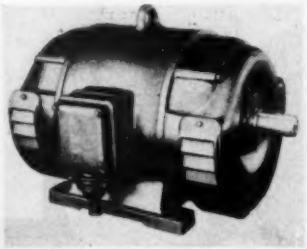


MACHINIST'S VISE P936

Malleable-iron machinist's vise has a new-type graphite-bronze self-lubricating thrust bearing at the front of the sliding jaw. This bearing absorbs the steel screw head to give easy and positive operation, and at the same time prevent wear and end play. Because of this bearing the vise can be pulled up tighter and held more securely with less pressure than ordinary vises require.

Columbian Vise and Mfg Co, 9021 Bessemer Ave, Cleveland 4, Ohio.

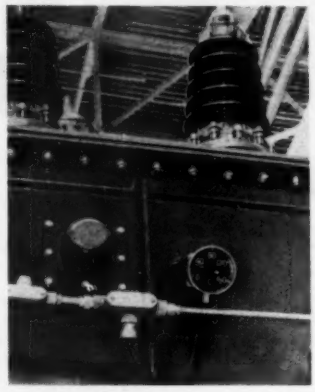
For more data on these items, use post cards, p163. Identify request with P and number.



COMBINATION MOTOR P930

All-in-one unit, combination brake-and-drive *Quick-Stop* motor, is for use where starts and stops are frequent. No outside power source or special controls are needed to apply or release the brakes. When power is cut, it brakes and stops with 150% of normal torque with no creep or backlash. Motors are available from 0.3 to 8 hp in drip-proof, and 0.3 to 4 hp in totally enclosed designs.

Brown Boveri Corp, 19 Rector St, New York 6, N. Y.

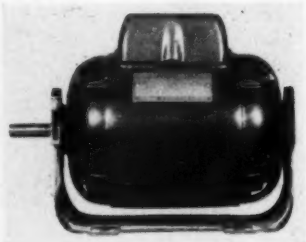


HOTSPOT INDICATOR P945

Line of winding temperature equipment for power transformers consisting of a hot-spot indicator-relay; a hotspot indicator for local indication; and a hotspot indicator for remote indication.

Hotspot indicator-relay (Type AWR) is the first device of its kind to provide, in one unit, accurate indication of hot-spot temperature as well as automatic starting of cooling fans, oil pumps, alarms, or any other circuit in the desired sequence and at a predetermined hot-spot temperature. The hot-spot indicator for local indication (type AW) is similar in construction to the type AWR indicator-relay except that the former has only one alarm contact. For remote indication, the type AW-400 detector coil (10 ohms at 25 degrees C) is furnished. All the new equipment can be removed and tested without de-energizing the transformer, lowering the oil level, or in any way interfering with the operation of the transformer.

General Electric Co, Schenectady 5, N. Y.



CAPACITOR MOTORS P949

Tri-Clad line of single-phase, capacitor, induction motors with a resilient-base construction. For use where freedom from vibration and extra-quiet operation are needed. Construction is available on motors rated from ½- to 5-hp.

Being a capacitor motor, it has no brushes or commutators to interfere with radio or television reception. This is important in hotel applications.

General Electric Co, Schenectady 5, N. Y.

VARIABLE-SPEED DRIVE P951

Designed for installations where driven-shaft speeds must be lower than motorshaft speeds. Unit utilizes 7- and 8-in. combination sheaves and is available for drives from 2 to 15 hp.

Assembly consists of a sealed ball-bearing countershaft stand, secured by rigid slide rods to an adjustable motor support for all motor sizes up to NEMA 326. The built-in control can be mounted in any one of a number of positions to suit the requirements of the installation.

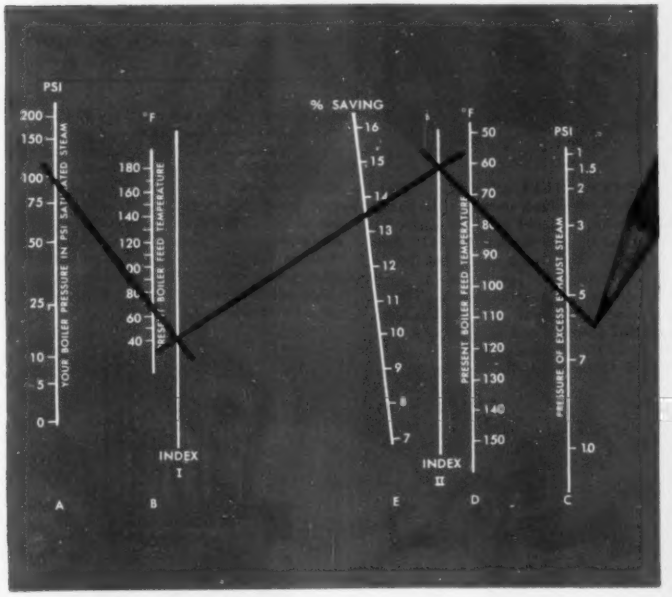
Speed Selector Inc, 118 Noble Court, Cleveland 13, O.

FIRE PROTECTION P911

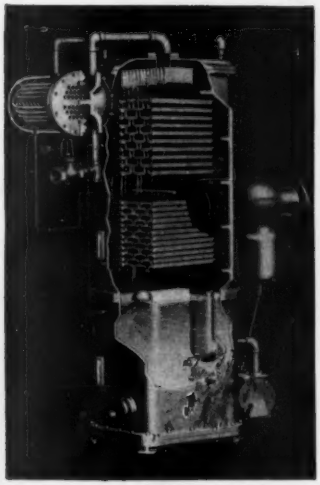
Fire protection for handling and storage of flammable liquids can now be had with the new mechanical foam system developed

Use this chart to figure fuel savings with a Swartwout Feed Water Heater

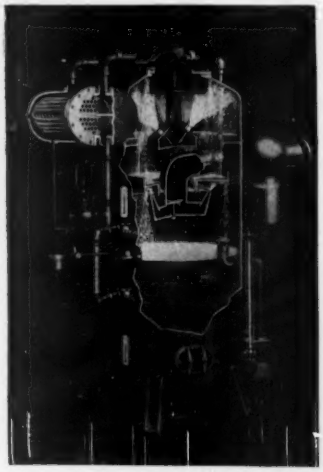
1 Here's how to figure your fuel savings with a Swartwout Feed Water Heater: Connect point on Scale A to point on Scale B and project line to intersect Index I. Connect point on Scale C to point on Scale D and project line to intersect Index II. Connect points on Index I and Index II and read percentage fuel savings on Scale E. The example given on nomogram—100 psi saturated steam boiler using 70°F feed water and 5 psi exhaust steam—shows a representative saving of approximately 13.6% of your present fuel cost.



2 By utilizing the residual heat in exhaust steam, Swartwout Feed Water Heaters can save you approximately 1% of your present fuel cost for each 11°F increase in boiler feed water temperature. In addition, you improve your boiler operation in other important, cost-cutting ways—faster steaming rate, temperature strain relief, removal by deaeration of soluble gases that cause boiler and economizer corrosion. Accessories are furnished to meet the requirements of each particular installation.



3 Swartwout cast iron or steel deaerating heaters (.03 oxygen guarantee) and deaerators (.005 oxygen guarantee) are supplied with cast iron or stainless steel trays. By using the counterflow principle the greatest degree of deaeration is obtained because the water is in contact with clean steam just before dropping into the storage section.



4 Swartwout all-steel spray heaters (atomizing type) give feed water with an oxygen content guaranteed not to exceed .005 cc per liter of water. All surfaces subjected to impingement of water are made of stainless steel. Swartwout heaters are specially engineered to your specifications.

A-3268

Swartwout

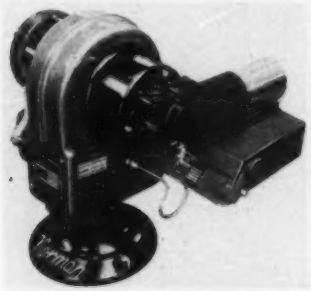
POWER PLANT EQUIPMENT

SEND FOR BULLETINS S-18-E, S-210 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

More EQUIPMENT NEWS

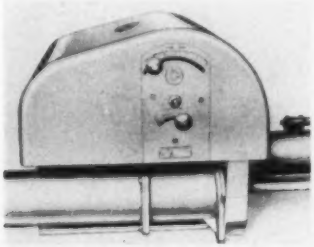
Begins on page 154

by the manufacturer. Generally this system depends on normal plant water pressure to draw, mix and deliver the fire-extinguishing agent. In large installations where main pressures are not high enough, special pumping may be needed. The components of the foam are water, foam-liquid and air.
Walter Kidde & Co, Belleville, N. J.



COMBINATION BURNER P933

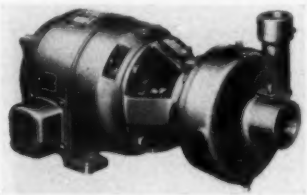
Automatic gas-to-oil-and-back burner can be operated from an outside thermostat set at the temperature point at which the gas utility expects service difficulties. Burner can also change fuels automatically, depending on drops or rises in pressure of the gas line. The twin fuel burner is of great value to commercial installations faced with possible gas shortage and freezes. Seven sizes from 80,000 to 3,000,000 Btu capacity. The smaller sizes are stainless steel, and the larger ones use high-temperature refractories and heavy cast-iron materials.
Norman Products Co, 1150 Chesapeake Ave, Columbus, O.



FUEL AIR METER P910

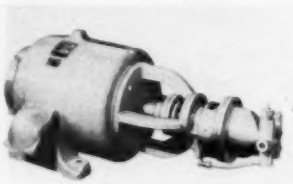
Material increase in over-all combustion efficiency results from use of an automatic linkage of fuel and air supply centered in the *Air Volumeter*. This device synchronizes the accurate coal-metering worm conveyor with the air supply from fan to boiler to give correct air-fuel ratios regardless of varying load demands.

Stoker's operating rate shows by the position of the upper quadrant of the control panel which can be connected directly to the power operator of a modulating combustion control or set manually. Any changes desired in the air-fuel ratio because of changes in coal characteristics or heating value can be effected by manually changing the "air ratio" quadrant.
Iron Fireman Mfg Co, 3170 W 106th St, Cleveland 11, Ohio.



STAINLESS-STEEL PUMP P914

A small centrifugal pump for the chemical, process, food and other industries has all wetted surfaces made of type 316 stainless steel. It is built in ¾- to 1½-in. discharge size, with power from ¼ hp at 1750 rpm and 2 hp at 3450 rpm. It has a leakproof mechanical seal, hydraulically balanced impeller and springtype flexible coupling. Catalog available.
Bell & Gossett Co, Morton Grove, Ill.



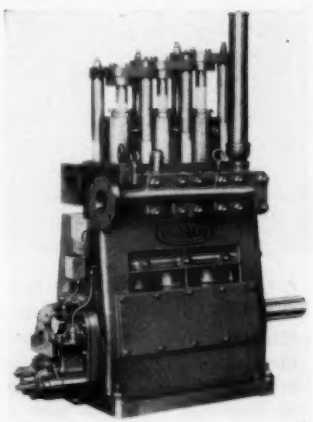
CONSTANT-DELIVERY PUMPS P916

These heavy-duty axial rolling piston pumps have a fixed stroke. Volume of oil they deliver varies with their drive shaft speed. They can operate at speeds up to 1800 rpm, and pressures of 5000 psi. Each unit consists of an axial rolling piston pump, a supercharging gear pump, a gear-pump relief valve and an adjustable reverse-flow high-pressure relief valve.

Over 10 hp is transmitted by units of 7x10x13-in. dimensions. They can be used on a wide variety of repetitive-cycle applications where controlled variable speed is not needed. They are suitable for heavy-duty pushing, pulling, lifting and lowering applications, and for holding high static loads on large clamping rams, and similar applications.
Oilgear Co, 1560 W Pierce St, Milwaukee 4, Wis.

FLAME FAILURE P937

Programing control as well as flame-failure protection with the *Fireye System* FP-2 consists of programing control Type 26 RJ8, and *Firetron* scanner Type 48 PT1. The scanner is compact in design and employs a photo-conductive cell that responds to all flames. It "sees" and checks the pilot flame and the establishment of the main flame whether gas, oil, or a combination of both. The programing control permits a preliminary purge of the combustion chamber and gives ignition-on, fuel valve delay, post-ignition timing and post-purge.
Combustion Control Corp, 77 Broadway, Cambridge, 42, Mass.



RECIPROCATING PUMPS P913

This direct-flow triplex unit has 3-in. stroke, and operates at speeds up to 500 rpm. Power ranges up to 50 hp, pressures to 3800 psi and displacement up to 96 gpm at 790 psi and 500 rpm. Fluid end is sectionalized to simplify maintenance. Changes in plunger size can be readily made to meet changes in pressure or capacity. Data sheet 64-A available.
Aldrich Pump Co, Allentown, Pa.

ASH HANDLING P938

Manual handling is not necessary with the new *Vac-Veyor* ash-handling system

(Continued on page 170)

For more data on these items, use post cards, p163. Identify request with P and number.

Now Take Another Minute To Check These . . .

Powder Metalizer unit for applying uniform overlays of alloys to base metals ..... p 172

Power Tool that's cartridge-powered. Sends steel-fastening slug in just about any material. Studs vary from ⅝ to 2¾ in. in length ..... p 172

Battery Charger uses a selenium rectifier ..... p 176

Heating Coils (steam) for air-conditioning, tempering or booster units ..... p 176

Speed Indicator measures to 48,000 rpm ..... p 178

WELDOLETS

WELDING FITTINGS FOR ANY PIPING SERVICE

NATURAL GAS COMPRESSOR STATION PIPING CONSTRUCTED ECONOMICALLY AND EFFICIENTLY USING WELDOLET WELDING FITTINGS THROUGHOUT

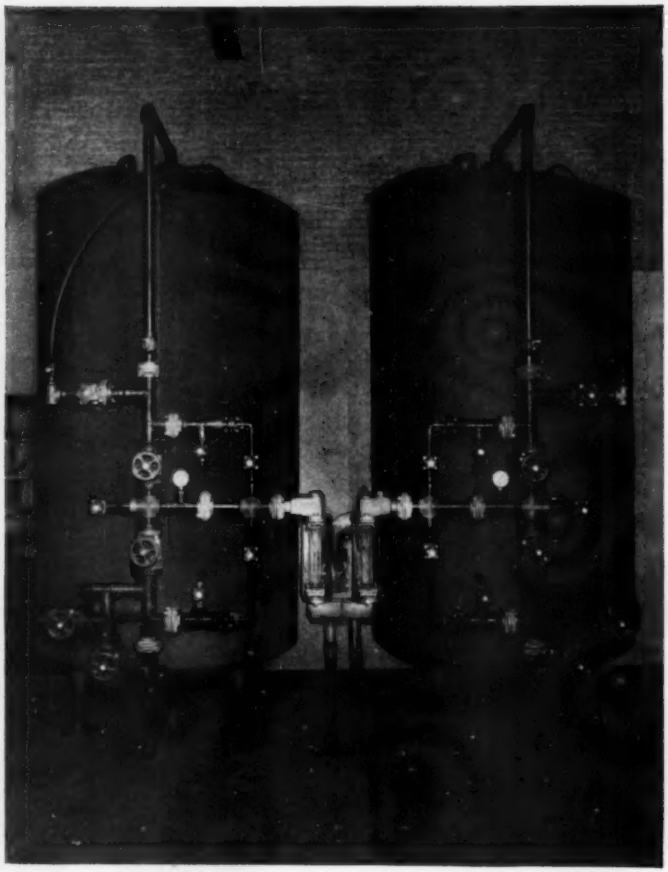
This installation, together with a number of important applications of WeldOlet Welding Fittings in various types of service is shown in the new Bonney W-3 WeldOlet Catalog.

The completely new Bonney catalog will furnish descriptions, dimensional information and installation instructions. The technical section demonstrates graphically how WeldOlet Welding Fittings offer the quickest, safest and most economical method of establishing and maintaining 100% pipe strength at branch connections in accordance with code provisions.

Write for your free copy to: BONNEY FORGE & TOOL WORKS 350 Grove St., Allentown, Pa.

Export Distributor: NATIONAL SUPPLY EXPORT CORP., 60 East 42nd Ave., New York 36, N. Y.

Silica < 0.01 ppm



DUPLEX MIXED-BED de-ionizing unit for Eastern public utility company, photographed during fabrication in the Illco-Way shop. Unit is designed to produce a water of the highest chemical purity including complete silica and CO_2 removal and with a composite resistance of 8,500,000 ohms per cm^3.

▶ SINCE THE FIRST Mixed-Bed De-ionizing unit* was introduced to the industry by the Illinois Water Treatment Co. in 1949, this method for purification has rapidly gained acceptance.

At the present time, according to ILLCO-WAY records, more than 2,500,000 pounds per hour, with silica content of less than 0.01 parts per million, are being produced by ILLCO-WAY Mixed-Bed* equipment.

With feedwater containing less than 0.1 parts per million ionizable solids, and with a composite resistance of 8,500,000 phms per cm^3, boiler and turbine maintenance is greatly reduced and operating efficiencies are improved.

Purity is constant regardless of load variations. ILLCO-WAY Mixed-Bed units are designed for either manual or automatic operation, and can be operated on raw water supplies or added as a final treatment to present conditioning equipment. Complete literature on de-ionizing can be secured by writing to ILLCO-WAY.

**Process and equipment patents pending.*

Analysis of Feedwater (Parts per million as $CaCO_3$)

(Analysis made by an independent laboratory of a feedwater produced by Illco-Way Duplex Mixed-Bed system)

Ca - 0	HCO_3 - 0.05	CO_2 - 0.04
Mg - 0	SO_4 - 0	SiO_2 - 0.01
Na - 0.05	Cl - 0	pH - 6.80

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

See data in Sweet's File, Engineering

ionXchange

ILLINOIS WATER TREATMENT CO., 853-9 Cedar St., Rockford, Illinois • 141 East 44th Street, New York City

Canadian Distributor: Pumps & Softeners Ltd., London, Ontario

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FREE CATALOGS AND BULLETINS

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

B1 **DEHUMIDIFIERS**—Describes dehumidifiers for instrument air. Each unit is equipped for electric regeneration and for fully automatic or semi-automatic operation. Capacities from 35 to 200 scfm air at 100 psig and 70 F. Operating data, prices, tables. 4-page bulletin No. DD-120. Industrol Corp, 472 Westfield Ave, E Roselle Park, N. J.

B2 **AIR CONDITIONER** — Presents data on the Trane self-contained air conditioner, available in 3, 5, and 7½-ton units. 4-page bulletin No. S-362. Trane Co, La Crosse, Wis.

B3 **HUMIDITY CONTROL**—Describes the electrically controlled concept of humidity measurement that makes possible direct humidity readings from remote locations. 4-page data sheet No. 10.5-4. Minneapolis-Honeywell Regulator Co, Brown Instrument Div, Wayne & Windrim Aves, Philadelphia 44, Pa.

B4 **DEHUMIDIFICATION** — Presents a few facts about dehumidification for industry and is concerned mainly with too high a humidity, its cause, the problems it brings, and what can be done to control it. 2-page bulletin. Abbeon Supply Co, 179-15 Jamaica Ave, Jamaica, New York.

B5 **CONCENTRATORS**—The Niagara Series A and Series 6600 no-frost concentrators along with applications are described respectively in bulletins Nos. 119 and 118. 2 pages each. Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.

BOILERS AND AUXILIARIES

B6 **COAL STOKERS**—Shows how the automatic respirator device in Combustioneer stokers use pneumatic-hydraulic pressure to control air supply. 4-page bulletin No. R-105. Steel Products Engrg Co, Springfield, Ohio.

★ **FACILITIES REPORT**—An illustrated report, listing production facilities and equipment for handling war contracts and subcontracts is available. Company's management, employees, history, products, railroad facilities, etc, also described. 18-page booklet No. HF121. Hapman-Dutton Co, 630 Gibson St, Kalamazoo, Mich. (*Write direct to manufacturer on company stationery giving name and title.)

(*Continued on page 164*)

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More FREE LITERATURE

B7 **AUXILIARIES** — The Thermix Corp offers a brief report on their activities, principals and their products. Also contains a list of field men and a partial list of Thermix projects. 36-page booklet. Thermix Corp, Greenwich, Conn.

CONTROLS, MECHANICAL

B8 **VARIABLE SPEED DRIVE**—Describes the Type 4C miniature variable speed drive with push rod ratio control. Force required to operate push rod at zero speed and at full load is 6 lbs. 1-page bulletin No. 4C. Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.

B9 **VISUAL CONTROL BOARDS**—Shows how visual control boards may be used to visualize operating effectiveness at a glance at any hour of any day. Typical applications given. 4-page bulletin No. 159-3. Visi-Trol Corp, 21460 W Eight Mile Road, Detroit 19, Mich.

ELECTRICAL EQUIPMENT

B10 **TERMINALS** — Technical information on a new line of self-insulated Sta-Kon terminals with insulation grip. Applications, advantages, methods of installation included. 2-page bulletin No. 84. Thomas & Betts Co, Inc, 44 Butler St, Elizabeth 1, N. J.

B11 **SECTIONALIZING BREAKER**—Describes the Heinemann Type 490 control unit for banked secondary transformer systems. Features, advantages, how to order information. 4-page bulletin No. 2015. Heinemann Electric Co, OSE Dept, Trenton, N. J.

B12 **BATTERY CHARGING EQUIPMENT**—Presents information on motor-generator fully automatic battery-charging equipment. 4-page bulletin No. 11-310. Electric Products Co, 1726 Clarkstone Road, Cleveland 12, Ohio.

B13 **MOTIVE - POWER STORAGE BATTERIES**—Here is a pocket-sized handbook of technical instructions and engineering data on the care of motive-power storage batteries. Includes sections on battery charging; care and operation; maintenance and repairs; parts; and technical data. 56-page handbook. Gould-National Batteries, Inc, Trenton 7, N. J.

B14 **CIRCUIT BREAKER PANELBOARDS**—Covers De-ion circuit breaker panelboards for the control and protection of lighting, appliances, and other power applications in capacities from 10 to 600 amperes. Also describes the circuits that supply them. 20-page booklet No. B-5260. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B15 **POWER PLANT COMMUNICATION SYSTEMS** — A discussion of the Gai-Tronics high and low level voice communication system designed expressly for power plants. Discussion includes: what it will do for you, how it operates, what it consists of, cost, and uses of system. 20-page bulletin. Gai-Tronics Corp, 412 Washington St, Reading, Pa.

MAINTENANCE MATERIALS

B16 **HAMMER BIT**—Shows and tells users how Thunderbolt carbide tipped hammer bits perform when drilling holes, under a variety of conditions, in hard concrete or granite. Specifications and prices included. 8-page folder. New England Carbide Tool Co, Inc, 60 Brookline St, Cambridge 39, Mass.

B17 **HEAT - RESISTANT PAINTS**—Gives application and product data for the five Speco heat-resistant paints. 1-page bulletin. Speco, Inc, 7208 Associate Ave, Cleveland 9, Ohio.

B18 **FIBRE AND SHEET PACKINGS**—Features complete line of asbestos and fibre sheet packings, with descriptions of each type packing, together with full service recommendations, standard sheet sizes, weights and thicknesses. 8-page bulletin. Raybestos-Manhattan, Inc, Packing Div, Manheim, Pa.

B19 **WOOD PRESERVATIVE**—Contains 60 specifications and an abstract of each, for the use of pentachlorophenol wood preservative issued by state, federal and armed forces agencies. 17-page bulletin. Monsanto Chemical Co, St Louis 4, Mo.

B20 **PLIER REPAIR**—How to get worn and damaged pliers back into useful shape is the subject of new booklet, "First Aid for Pliers." Utica Drop Forge & Tool Corp, Utica 4, N. Y.

B21 **CHEMICAL CLEANING** — Describes chemical cleaning and descaling of industrial heat exchange equipment, the Solvent Service way. They specialize in service for steel mills, chemical process industries, industrial power plants, utilities, marine industry and water wells. 4-page bulletin. Solvent Service, Inc, Painesville, Ohio.

B22 **SCALE REMOVAL** — Tells how Oakite Compound No. 32, an inhibited material, dissolves scale and rust deposits in heat exchange equipment. 28-page booklet. Oakite Products, Inc, 32 Thames St, New York 6, N. Y.

MATERIALS HANDLING

B23 **GRAB BUCKETS** — Three grab bucket bulletins available. Type RD designed to work on ends of operating lines of man trolley ore, and coal bridge and tower installations—bulletin No. RD-1. Type C "bight of line" for fleet-through operation on rope system bridges and towers—bulletin No. C-1. Type R for steeple type towers—bulletin No. R-1. 6 pages each. Mead-Morrison Div, McKiernan-Terry Corp, Dept 2, Harrison, N. J.

B24 **CHAIN DRIVES AND CONVEYORS** — Bulletin, "Installation, Operation, and Maintenance of Chain Drives and Conveyors," shows how to get the most service from your sprocket chains. 32-page bulletin No. 51-7. Chain Belt Co, 1600 W Bruce St, Dept PR, Milwaukee 4, Wis.

B25 **EXCAVATORS**—Lists condensed specifications and types of service to which excavators can be converted for such use as shovel, dragline, backhoe, crane, etc, and also gives crane lifting capacities. 32-page bulletin No. 403. Marion Power Shovel Co, Marion, Ohio.

MECHANICAL TRANSMISSION

B26 **MAGNETIC DRIVE** — Discusses precision speed control with the adjustable-speed magnetic drive and new magnetic amplifier Regutron speed control. Charts, diagrams, and illustrations included. 32-page booklet No. 1107. Electric Machinery Mfg Co, Minneapolis 13, Minn.

B27 **PILLOW BLOCKS**—Pointers on the construction, application and installation of pillow blocks ranging in sizes to take shafts 1 15/16" to 9" in. diameter. Includes engineering data, bearing capacities, lubrication information, dimension drawings, types and sizes. Catalog No. 85. W A Jones Foundry & Machine Co, 4401 W Roosevelt Road, Chicago 24, Ill.

METERS, INSTRUMENTS, ELECTRIC

B28 **HIGH SPEED RECORDER**—Describes a high speed Electronik recorder which features a one-second

(*Continued on page 220*)

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BOOKSHELF

SELECTED FOR YOU IN THIS ISSUE:

TORQUE CONVERTERS OR TRANSMISSIONS
AC ARMATURE WINDINGS
POLYPHASE INDUCTION MACHINES
ELECTRICAL INSULATION
REVIEW OF CURRENT RESEARCH
THERMODYNAMICS OF FLUID FLOW
SERVOMECHANISMS, REGULATING SYSTEMS
FLUID MECHANICS
INTRODUCTION TO HEAT TRANSFER
AIRCRAFT JET POWER PLANTS

FEATURED THIS MONTH

GUIDE TO EVERY IMPORTANT ELECTRICAL-INSULATION PROGRAM

ELECTRICAL INSULATION, ITS APPLICATION TO SHIPBOARD ELECTRICAL POWER EQUIPMENT. *By Graham Lee Moses, mgr, insulation development section, Westinghouse Electric Corp. 259 pp, 7¾x10¼ in., $5.50. McGraw-Hill Book Co, 330 West 42nd St, New York 18, N. Y.*

Even though the title slants this book toward shipboard equipment, it covers the insulation field in a way applicable to stationary plant electrical equipment. We can consider this book as a guide covering every important phase of electrical insulation.

The author begins with the basic concepts of electrical insulation, discussing fundamental insulation terms, properties and theories. He goes on to describe the classes in insulation in accord with AIEE and ASA standards. The selection of insulations is treated in terms of their physical, electrical and chemical characteristics.

Of immediate interest to power engineers is the section dealing with insulation testing. Here are discussed turn-to-turn tests, ground tests, etc, along with emergency tests useful if conventional tests fail. The important steps in setting up an effective maintenance and inspection program are outlined.

The final chapter is a compact summary of facts for quick reference. It lists the *do's* and *dont's* on installation and maintenance of electrical insulation.

Torque Converters

TORQUE CONVERTERS OR TRANSMISSIONS *(1951—fourth edition). By P M Heldt, 476 pp, 5¼x8¼ in., illust, cloth. $6. P M Heldt, Nyack 9, N. Y.*

When a whole plant or part of it was driven by a single power unit, belts, pulleys, gears, clutches and other mechanical power-transmission equipment were used on a grand scale. The electric motor was heralded as a power unit that would eliminate all this complication of equipment. It did, but to meet modern power-application requirements all the older types of equipment in improved form are still with us and a lot of others, such as hydraulic torque converters, hydraulic and magnetic drives, and a host of others.

This book covers many forms of gearing, clutches and combinations of them. These include friction clutches, automatic clutches, hydraulic and electric drives, overrunning clutches, gearing, planetary transmissions, and many combinations. The treatment is largely practical explanations of how these equipments operate and are used. Even though written for the transportation field, this book has much to help power and industrial engineers to a better understanding of modern power transmissions.

Advanced Hydraulics

FLUID MECHANICS *(1951). By V L Streeter, research professor in mechanics, director of fundamental fluids research, Illinois Institute of Technology. 366 pp, illust, charts, 6x9¼, $5. McGraw-Hill Book Co, 330 West 42nd St, New York 18, N. Y.*

An advanced book in hydraulics using calculus and differential equations. Relatively new phenomena in relatively elementary terms are explained to emphasize the physical aspects before advancing to the mathematical treatment.

The author lays the basis of the science in the first three chapters on pressure intensity, static pressure forces, fluid flow concepts. He then applies these basic principles to analyzing various types of fluid machinery and instruments. In turbomachinery he analyzes forces on elbows, fixed and moving vanes, turbines, pumps, blowers and jet engines. In laminar flow the book covers Reynolds number, viscosity, lubrication. Various methods of flow measurement are investigated. Flow through both closed conduits and in open channels are included in the text.

Over 40 pages are devoted to the study of flow around immersed bodies. These are important in the aeronautical and marine applications and others. The book closes with a chapter on oil hydraulic systems.

Ac Armature Windings

ALTERNATING-CURRENT ARMATURE WINDINGS *(1951—first edition). By Charles S. Siskind, assistant professor of electrical engineering, Purdue University. 236 pp, 6x9 in., 154 illust, 11 tables, cloth. $5. McGraw-Hill Book Co., 330 W 42nd St, New York 18, N. Y.*

This is a companion book to the author's *Direct-Current Armature Windings*, and like it, is a carefully planned simplification of present-day winding practices. Various types of windings for single-phase and polyphase machines are treated in detail. Many examples are given to illustrate important ideas, and are supplemented by clear-cut diagrams and photographs. Material has been carefully planned so simple coil and winding procedures gradually lead into the more complex arrangements.

Considered first are single-phase windings—spiral-concentric and skein-types—as used in repulsion and split-phase motors. Then follows a study of concentric-chain polyphase windings, which are a variation of the type common to single-phase machines. Polyphase wave and lap windings are then taken up to complete the important list of modern winding types. Multispeed windings for single-phase and polyphase motors are treated in a way that is original and easy to follow.

The book is written for college students, but except for ten pages in the second chapter, it is one of the most practical treatments of ac machine windings available. The author is to be congratulated for doing such a swell job—one that serves practical shop men as well as college and vocational-school students.

Heat-Transmission Fundamentals

INTRODUCTION TO HEAT TRANSFER *(2nd edition, 1951). By A I Brown, chairman, Dept of Mechanical Engrg, and S M Marco, professor of mechanical engrg, The Ohio State University. 267 pp, illust, charts, tables, 6¼x9¼, $4.50. McGraw Hill Book Co, 330 West 42nd St, New York 18, N. Y.*

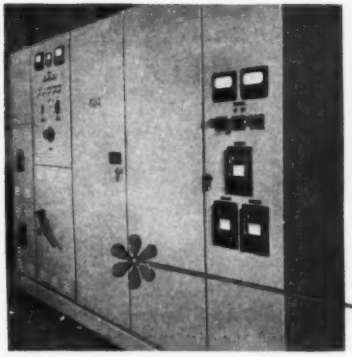
The new edition maintains the original intention of giving the essential fundamentals of heat transmission in a form that engineering students can easily grasp. The basic principals and development of the most common mathematical expressions applied to heat transfer calculations are emphasized. Advanced math is kept to a minimum.

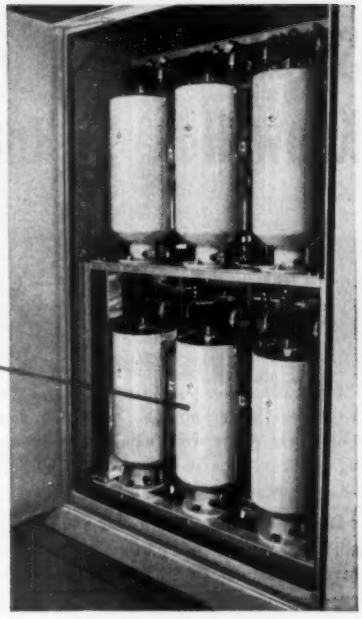
Changes in the new edition include: revisions in material on estimating heat conduction by mapping method; new material relating to characteristics of insulating materials and calculation of solar radiation; considerable expansion on relationship between fluid flow and heat transfer; revised nomenclature to conform to current standards; table of conversion factors; graphs of physical properties of liquids and gases, revised to show recent data, additional problems.

(*Continued on page* 184)

Don't build around obsolete DC supply

—RETIRE IT NOW!





Modern Allis-Chalmers factory packaged, sealed tube, 500 kw mercury arc rectifier as installed in midwestern industrial plant. Left: "dead-front" compartments for dc feeders, dc metering and cathode breaker, rectifier tubes, and ac control and metering. Right: interior view of mercury arc rectifier tube compartment.

NOW IS THE TIME to retire obsolete converting and generating equipment. As operations expand, this inadequate equipment will become a growing handicap.

Now too — while there is a favorable base for amortization — is the time to consider mercury arc rectifiers for your expansion plans. Let Allis-Chalmers show you how the *modern* mercury arc rectifier can improve your direct current service.

LOW MANPOWER REQUIREMENT. With push-button starting and no synchronizing required, attendants are not needed during normal operation. Downtime for maintenance is reduced with no moving parts to lubricate or wear.

LOW COST OPERATION. Conversion efficiency is higher at all loads with large power savings during light load periods.

CONVENIENT INSTALLATION. Factory packaged, light in weight, and requiring no special foundation, Allis-Chalmers mercury arc rectifiers may be placed right at the load center.

IMPROVED PLANT OPERATION. With dc load center installation, distribution distances are cut, dc feeder losses are reduced, and full voltage is available at production equipment.

Whatever your specific direct current needs, Allis-Chalmers builds suitable and truly modern mercury arc rectifiers to meet them.

Sealed tube rectifiers (as shown above) are supplied in ratings from 200 to 1000 kw for lighter duty service. These are commonly used in large buildings, industrial plants and electric haulage systems. Pump evacuated rectifiers are built from 750 kw to the largest ratings required for heavy duty applications.

An Allis-Chalmers representative will be glad to explain in detail how these modern mercury arc rectifiers will improve the operation of *your* direct current system. Call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3467

ALLIS-CHALMERS AC

MERCURY ARC RECTIFIERS

Since When Do Politicians Know How to Run a Power Plant?

Boy! I really burned last week when I read that the superintendent of a nearby municipal power plant was let go because he opposed the mayor *on what should have been a purely engineering decision.*

First let me give you what I know of the background. A little over four years ago, the town's diesel generating station was pretty well run down and had been operating for some time in the red. A good engineer seemed the only answer.

Meanwhile, Bill, we can call him, had been building quite a reputation for putting plants on their feet. So the town sent for Bill to bail them out. And he did.

Within a very few months Bill was able to start showing a profit. He overhauled the plant and installed a new engine. And since his first year, the plant has been paying off over $100,000 a year.

But the town has been growing and more capacity will soon be needed. Bill thinks the plant should be expanded. The mayor wants to produce the extra power by buying excess steam from a nearby plant.

So the argument was settled by firing Bill.

What went on behind the scenes, I don't know. Which course of action would have been best, I don't know.

But I do know that Bill is an engineer of proven ability. And like any engineer worth his salt, he would never make an important decision like this without first getting all the facts on paper and figuring out the answer in plain dollars and cents.

Evidently political decisions aren't made that way.

Since all the facts involved will probably never be known, all I can say is: Congratulations, Bill, on sticking to your guns.

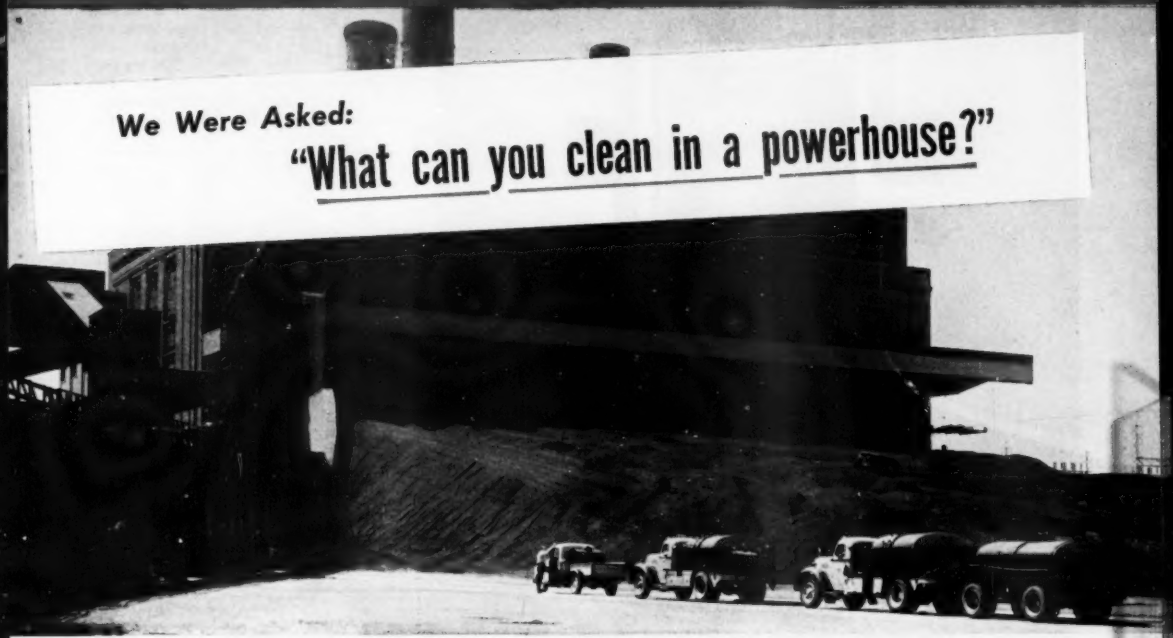
And if anybody is looking for a top-notch engineer, I know where he can find one.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



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There are many places in every industrial plant where Dowell Service can cut operating costs and *increase production time*. Wherever deposits on the surfaces of condensers, boilers, heat exchangers, water lines and other equipment are reducing capacity, Dowell Service can show money-saving results.

Dowell furnishes trained personnel and all necessary special equipment. Dowell engineers apply liquid solvents according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing. The solvents are designed to remove deposits *quickly*, efficiently and economically. Dismantling is unnecessary and downtime is kept to a minimum. Often equipment can be cleaned while it is in operation.

Experienced Dowell engineers will be glad to consult with you on your particular problems. Call the nearest Dowell office today!

BOILER: A boiler was making only 12,000 lbs. of steam per ton of coal. After Dowell Service, the output increased to 18,000 lbs. of steam per ton of coal.

ECONOMIZER: A return-bend, integral economizer was cleaned by Dowell Service in 8 hours with no dismantling.

SUPER HEATER: Several tubes had blown out on a pendant type, non-drainable superheater because of heavy deposits. In just two working days Dowell Service did a complete job of removing these troublesome deposits.

TURBO SURFACE CONDENSER: An 800 KW Turbo Condenser was cleaned by Dowell. Result: The drop in steam rate demand represented an estimated yearly savings of $3600 in coal.

EVAPORATOR: Before cleaning, an evaporator operated at 24 lbs. per square inch steam and 11 inches of vacuum. After Dowell Service, it operated at 4 psi. steam and 13" vacuum.

HEAT EXCHANGER: Pressure drop on a heat exchanger was 52 lbs. with 150 gallons per minute flow. After Dowell Service, pressure drop was 22 lbs. with 200 g.p.m. flow.

BOILER FEED LINES: Before cleaning, it was necessary to use three 100 horsepower pumps to force water through clogged feedlines to the boiler house. Following Dowell Service, only one pump was required.

PUMP: Two high pressure feedwater pumps were nearly clogged with deposits. Dowell Service cleaned them along with the rest of the feedwater system.

TURBINE: Deposits on the rotor and stator of a turbine were removed quickly and efficiently by Dowell Service *in three hours.*

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Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

★ *Maintenance cleaning service for industrial heat exchange equipment.*
★ *Chemical services for oil, gas and water wells.*
★ *Magnesium anodes for corrosion control.*

DOWELL

A Service Subsidiary of

THE DOW CHEMICAL COMPANY

Look to these five reasons for long, trouble-free service in STRONG 70 Series Traps:

1. *Valve and seat guaranteed leakproof for one year—made of STRONG's patented, wear-resistant Anum-Metl;*
2. *Easy servicing—permitted by the renewable seat design, cover with all working parts easily removed without breaking pipe connections;*
3. *One piece bucket—stainless steel, no welds;*
4. *Turbulence avoided, choking minimized, 25% greater capacity—with STRONG's exclusive Hi-Cap orifice;*
5. *No dribbling, quick, full opening—high ratio leverage.*

STRONG *in-line* 70 Series Traps are available in sizes from ½" to 1", semi-steel construction. STRONG's "two-in-one" blast trap with integral thermal air vent is also available in the 70 Series (see cut below).

Catalog No. 68-P describes these traps in detail along with other STRONG traps. Write today.

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OTHER STRONG STEAM SPECIALTIES

Reducing Valve | Blast Trap | "SY" Strainer

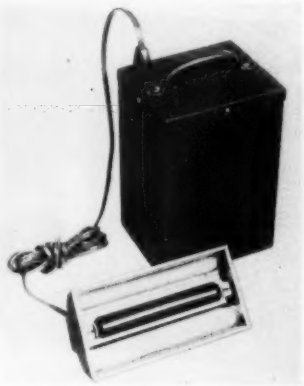
STRONG

More EQUIPMENT NEWS

Begins on page 154

that conveys ash, soot and dust in a dry condition under the pull of a vacuum through pipe's from the system intakes to a receiver on top of an ash-storage silo. A steam exhauster beyond the ash receiver creates the vacuum and at no time does the ash come in contact with the steam.
Beaumont Birch Co, Philadelphia, Pa.

For more data on these items, use post cards, p163. Identify request with P and number.



LEAK DETECTOR **P926**

New, effective method for detecting liquid leaks in vessels of all kinds and sizes develops from the use of fluorescent agents. An extremely dilute solution of the agents is placed inside a container or vessel to be tested. The slightest flow through the wall is signaled by a bright glow under the influence of rays from a special leak-detector exploring lamp, the *Raymaster* Model TSS-4 B 90. The detector has to be used in a darkened area.
George W Gates & Co, Hempstead Turnpike & Lucille Ave, Franklin Sq, L. I., N. Y.

METAL SNIPS **P906**

Special-compound leverage design gives maximum cutting with least effort in new metal snips. These snips, available for right-hand cutting, left-hand, or for both cuts, have 2½-in. forged chrome-vanadium steel jaws, serrated for a better grip on the work. Snip, 9¾-in. overall, can sheer sheet metal, stainless steel and duraluminum.
Bonney Forge & Tool Works, Allentown, Pa.

AIR FILTER **P907**

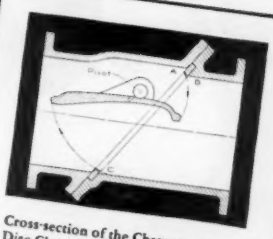
Absolute air filter developed originally for the Atomic Energy Commission is said to remove better than 99.98% of all dust, smoke, fumes, radioactive particles, spores,

CHAPMAN

TILTING DISC CHECK VALVES

Cut Maintenance Costs

with Cushioned-Closing



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

There's less wear on seating surfaces, hinge pins and bearings with the cushioned closing action in a Chapman Tilting Disc Check Valve. No destructive slamming. No fatiguing flutter. No vibration of pipe lines or adjacent structure — nor danger of opening pipe joints or rupturing pipe lines. Just a quick and quiet closure that cuts maintenance costs.

And what's more, the balanced streamlined discs in Chapman Tilting Disc Check Valves ride smoothly on the stream—reduce head losses 65 to 80% over conventional swing type checks. You'll want to know more about this maintenance-saving, more efficient check valve. Write today for engineering data, Bulletin #30.

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INDIAN ORCHARD, MASSACHUSETTS

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VALVES

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Bar Stock
Valve

R-P&C Bar Stock Valves are an achievement of the valve makers' craft. They are precision turned . . . from carefully tested metals . . . and suitable for a wide range of pressures and temperatures . . . for meter, gauge, test, and general purposes.

● Rugged construction of R-P&C Bar Stock Valves means long, low-cost, trouble-free service. No better bar stock valves are made. See your R-P&C distributor today or write the nearest R-P&C district office for information.

ACCO
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

"Intentionally Better"
READING-PRATT & CADY VALVES

More EQUIPMENT NEWS

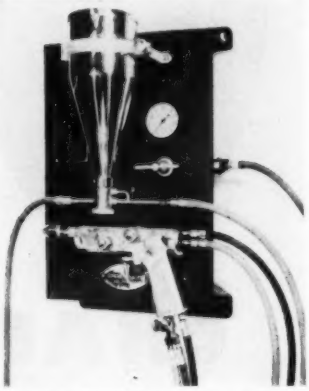
Begins on page 154

according to its manufacturer. It is now being produced in quantity for commercial use and comes in two standard sizes with rated capacities of 500 to 850 cfm.

The filtering material is a soft, felt-like paper made of specially treated pulp containing very few asbestos fibers. Paper is folded and packed in an accordion pleat. Dimensions are 24x24x5 7/8 in. deep for the 500-cfm size and 11½-in. deep for the 850-cfm unit.

Cambridge Corp, 350 S Geddes St, Syracuse, N. Y

For more data on these items, use post cards, p163. Identify request with P and number.



POWDER METALIZER **P908**

Light, powder-metalizing unit, the new *Spraywelder,* for applying uniform overlays of Colmonoy hard-facing alloys to base metals has an eye-level air gage, large air filter, positive air and powder control valves, a fingertip trigger control for continuous or intermittent spraying.

Wall Colmonoy Corp, 19345 John R St, Detroit 3, Mich.

POWER TOOL **P939**

A cartridge-powered tool, readily operated by one man and weighing about 5 lb, can operate at sustained speed of 5 or more stud settings a minute. Studs vary in length from ⅝ to 2¾ in. long and are made of specially developed steel alloy to resist shattering when driven.

The operator slips end of stud into a plastic steel cap or cup, opens the tool, places a loaded cartridge in the chamber,

THIS INGERSOLL-RAND Class HT pump No. 7C was installed in 1938 in the Windsor Station. Windsor Station is owned jointly by The Ohio Power Company (American Gas and Electric System) and the West Penn Power Company. Since that time the pump has chalked up a service record of 82,659* hours of operation — pumping rated capacity of 1025 gpm to approximately 1900 psi discharge pressure from suction conditions of 415 psi and 380° F.

It has never been opened for inspection.

This is one of six I-R high-pressure boiler-feed pumps at the Windsor Station. The others are giving fine performance also. Four of these were installed in 1941. Here are their records*:

Pump No. 7D	60,277 Hours
Pump No. 8A	53,880 Hours
Pump No. 8B	56,357 Hours
Pump No. 8C	65,063 Hours
Pump No. 8D	37,049 Hours

**Hours of operation up to October 1, 1950*

Here's why performance records like this are routine for I-R boiler-feed pumps

This kind of *dependability* doesn't "just happen"!

It's the end result of the extra care and precision, and the many years of experience that go into every step of Ingersoll-Rand pump manufacture — from selection of raw materials to final acceptance tests.

And it's here — on the job in leading power plants throughout the Nation — that I-R boiler-feed pumps have repeatedly proved their superiority for continuous, trouble-free, high-pressure service.

Whatever your boiler-feed application, there's an Ingersoll-Rand pump that's *right* for the job — a pump you can install with complete confidence in its sustained, high-efficiency performance. Your nearest I-R representative will be glad to give you complete information.

Ingersoll-Rand 569-10

CAMERON PUMP DIVISION
11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR AND ELECTRIC TOOLS • ROCK DRILLS • TURBO BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

PEABODY BURNERS for any kind of fuel

LIQUID
Acid Sludge
Water Gas Tar
Oil Gas Tar
Alkaline Sludge
Pitch

GAS
Refinery Gas
Coke Oven Gas
Blast Furnace Gas
Hydrogen Sulphide Gas
Sewerage Gas
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SOLIDS
Petroleum Coke
Oat Hulls
Saw Dust
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Peabody Engineers have analyzed and successfully solved hundreds of unusual combustion problems throughout the world involving many widely varying types of liquid, gaseous and solid fuels. Continual research and development make Peabody Burners the *preferred* equipment — dependable, satisfactory and trouble-free. Each installation is custom-engineered to meet specific operating requirements and its satisfactory performance is assured by more than 30 years of successful combustion experience. Inquiries on combustion problems of any kind are always welcomed. No obligation.

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ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers

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PEABODY LIMITED • LONDON, S.W.1, ENGLAND

769

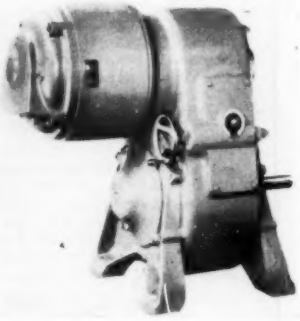
More EQUIPMENT NEWS

Begins on page 154

and closes the tool. It is now ready for firing. A neoprene-lined steel guard is attached to the muzzle of the tool. Without this guard the tool cannot be fired. Operator presses the guard firmly against the work surface, depresses the safety button and holds it in that position with one hand. Then he fires the tool by squeezing the trigger with the other hand.
Remington Arms Co Inc, Bridgeport, Conn.

For more data on these items, use post cards, p163. Identify request with P and number.

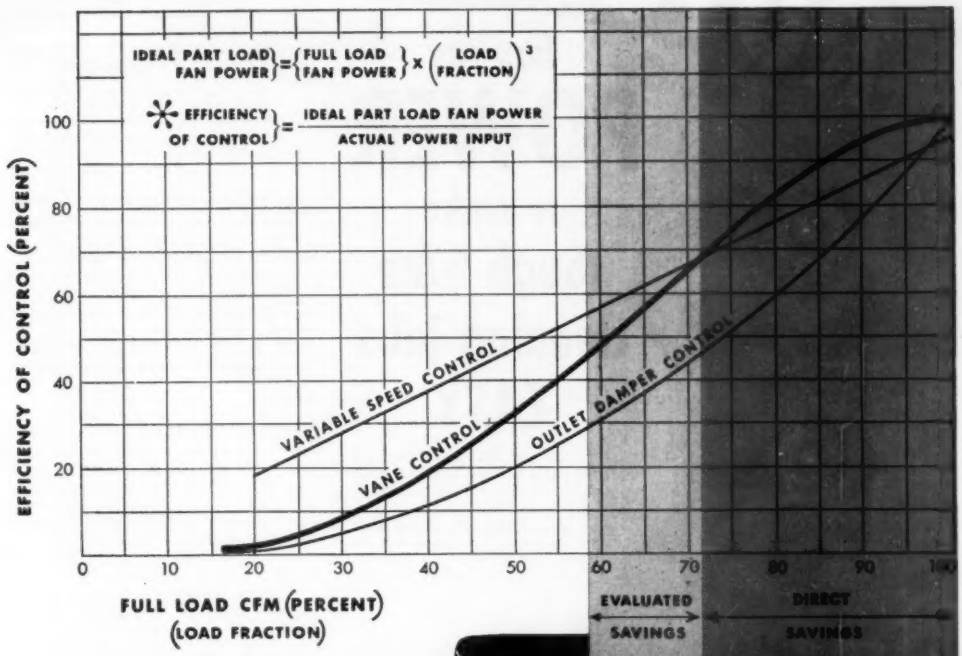
PULLER CONVERSION **P902**
Screw-operated bearing, wheel puller can be adapted to work on the company's new *Power-Twin* hydraulic puller. The set, *Y-150*, consists of a *Y-17*, 17½-ton *Power-Twin* ram and pump assembly plus adapter parts.
Owatonna Tool Co., 378 Cedar St, Owatonna, Minn.



POWER DRIVE **P935**
Larger horsepower *Speed-Tron* electric-power drive, designed to meet a drawing demand for variable-speed drive to 20 and 25 hp ratings, are now available in drip-proof models. They prevent liquids and other foreign material from falling into the motor. The motor housing and variable-speed transmission case are rugged, gray,

FOR PART LOADS

USE STURTEVANT VANE CONTROL®
FOR HIGH EFFICIENCY AT LOW COST



If you operate in this range—and most plants do—VANE CONTROL is the economical choice

Have you ever considered the relative efficiencies of methods of mechanical draft fan volume control—and then evaluated them against first cost? Do so, and you will find Sturtevant Inlet VANE CONTROL is the best. It is high in *efficiency of control** and low in first cost.

Whether for forced or induced draft, the *new* VANE CONTROL is a simple and reliable regulator of fan output—a control which responds instantly to varied demands, and yields major power savings at reduced loads.

A new Bulletin, DB 92-810, describes the mechanical improvements developed for Sturtevant VANE CONTROL and its use in mechanical draft, industrial and ventilating applications. Write today for a free copy. Westinghouse Electric Corp., Sturtevant Division, 157 Damon St., Hyde Park, Boston 36, Mass.

YOU CAN BE SURE...IF IT'S **Westinghouse**

PUTTING *Air* TO WORK

J-80220

ROTOJET
®
has the
POWER
to make
tough tube
cleaning jobs
EASY
Power is the stuff that makes the new ROTOJET stand out from all other tube cleaners. It makes tough jobs ridiculously easy Uses less air, too. Get a powerful, rugged ROTOJET, and no other cleaner will ever satisfy you Air or water-driven models for practically any size straight or curved tubes

ROTOJET Air-driven Motor Model 525 with swing-frame head and universal joint for 2⅝" to 3" I.D. curved tubes.

ELLIOTT COMPANY-ROTO DIVISION

More EQUIPMENT NEWS

Begins on page 154

iron castings for corrosion-proof properties. Outstanding features are positive pulley adjustment, infinite-speed variation and accurate control of speed under varying loads. The company plans to make available splash-proof and totally-enclosed fan-cooled models, with built-in reduction gears for lower speed ranges.

Sterling Electric Motor, Inc, 1501 Anaheim-Telegraph Road, Los Angeles, 22. Calif.

For more data on these items, use post cards, p163. Identify request with P and number.

ELECTRICAL CONDUIT P946

Dekoron coated galvanized electrical metallic tubing. Coating is corrosion resistant polyethylene. This coating is not substantially affected at room temperatures by concentrated hydrochloric, sulfuric or hydrofluoric acid. Hence is well suited for corrosive atmospheres.

Steel and Tubes Division, Republic Steel Corp, 224 E. 131 St, Cleveland 6, O.

BATTERY CHARGER P947

Operated on the selenium rectifier principle, this charger, for industrial truck units up to 55 amp-hr capacity, is designed to simplify operation and prolong battery life. Automatic controller governs amount and time of charge. There are but three simple steps; plug it in—set clocks—and throw switch.

Available for either lead-acid or nickel-alkaline batteries, the charger can be plugged into any standard 110/115-volt 60-cycle outlet. No special wiring is necessary. A step-down transformer is furnished for 220-volt outlets. Other capacities for larger batteries will be available in the near future.

The Yale and Towne Mfg Co, 11,000 Roosevelt Blvd, Philadelphia 15, Pa.

HEATING COILS P927

New line of steam heating coils for use with air-conditioning or tempering and booster units in long heating ducts is available in both single- and double-row designs. The single-row serves best for booster and tempering service and the double-row for heavy-duty or mixed air heating surface. Capacities range from 60,000 to 775,000 Btu per hr. Units are made of heavy gage steel casings, copper tubes and headers and seven aluminum fins per in. of tube.

Rempe Co, 340 N Sacramento Blvd, Chicago 12, Ill.

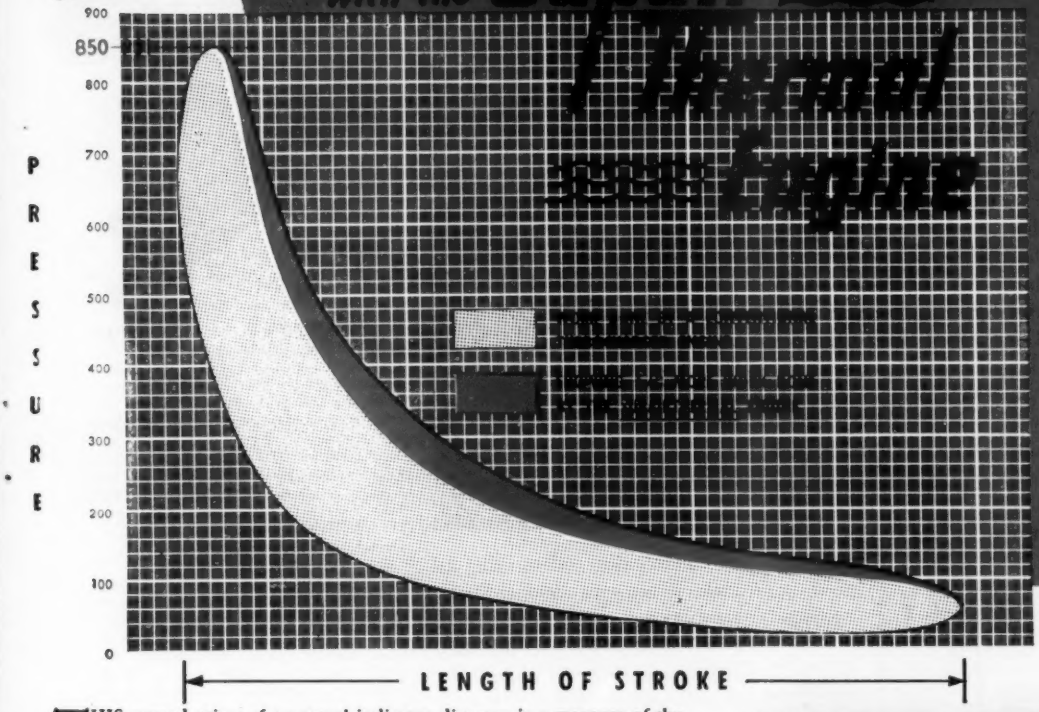
INDUSTRIAL CLEANER P929

Vibrating air valve creates, by jet principle, an agitating suction to force dirt and metal particles into a container. This container is supported on the individual's back by a conventional belt and harness assembly. The cleaner operates by finger-tip control valve with air consumption held to a minimum by automatically shutting off the

ONE-THIRD MORE POWER

Here it is...

with the Supair Thermal 3000 Engine



THIS reproduction of an actual indicator diagram is a measure of the average pressures within the cylinders of the *SUPAIRTHERMAL* Engine* and a conventional turbocharged engine. The darker area shows the amount of work being done by each piston in the conventional engine. The *solid red* area shows the *increase in the amount of work* done by each piston in the Nordberg *SUPAIRTHERMAL* Engine—*resulting in an increase of one-third in horsepower without increasing the maximum combustion pressure or the internal temperatures.*

Here, then, is actual proof that the Nordberg *SUPAIRTHERMAL* Engine *is* the outstanding engine of the Diesel field . . . delivering one-third more horsepower in the same space as a conventional turbocharged engine.

The *SUPAIRTHERMAL* Engine is available in a full range of 4-cycle types for fuel oil, Duafuel, or spark ignition gas operation, in sizes from 425 to 3200 B.H.P. Write for further information on the *SUPAIRTHERMAL* Engine, outlining your power requirements. *(Patents Pending).

NET RESULTS:

• 1/3 MORE HORSEPOWER IN SAME FLOOR SPACE • MORE HORSEPOWER PER GALLON OF FUEL • MORE HORSEPOWER HOURS PER GALLON OF LUBE OIL • INCREASED THERMAL EFFICIENCY • LESS HEAT LOSS TO WATER JACKETS • LESS WEIGHT PER HORSEPOWER • LOWER INSTALLATION – OPERATING – AND MAINTENANCE COSTS.

NORDBERG MFG. CO., Milwaukee 7, Wis.

P-SM251

BUSCH-SULZER
A DIVISION OF NORDBERG

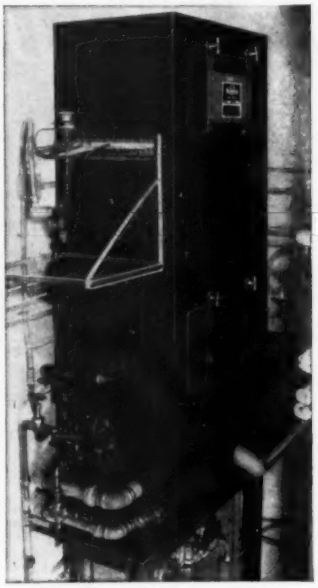
NORDBERG
DIESEL ENGINES

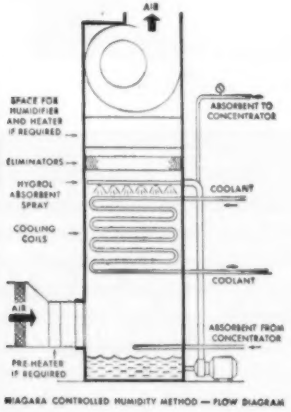
New "Controlled Humidity" Method Gives a Better Solution to Air Conditioning Problems

"Hygrol" Absorbent Liquid Dehumidifies Fresh Air Without Refrigeration

NIAGARA Air Conditioners or Dehumidifiers using "Hygrol" liquid absorbent give precise control of air temperature and humidity... at lower operating cost, with large savings in space and with smaller and less expensive equipment, in many applications.

This method dehumidifies the air by passing it through a chamber in which "Hygrol" spray removes its moisture and produces a low dew point. The "Hygrol" solution resulting is continuously and automatically re-concentrated, providing always full capacity in air conditioning and assuring always a constant dehumidifying capacity and a trustworthy, constant condition for your material, apparatus, process or room to be conditioned.





NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

"Hygrol" is a liquid, not a salt solution; it stays pure and non-corrosive; it does not cause maintenance or operating troubles in food plants or in chemical processes.

Investigate this new Niagara Method for "comfort" air conditioning as well as to protect quality in hygroscopic material, or processes or instruments, or to prevent condensation damage to metals, parts or products.

Write for Specific Information

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

Dept. P, 405 Lexington Ave. New York 17, N. Y.

Experienced District Engineers in all Principal Cities

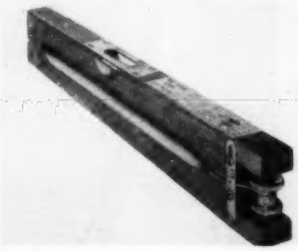
More EQUIPMENT NEWS

Begins on page 154

vibrating valve action 2000 times per minute. The cleaner head is polished aluminum and the wands are lightweight tubing.

Patterson Products, 518 Maccabees Bldg, Detroit 2, Mich.

For more data on these items, use post cards, p 163. Identify request with P and number.



PITCH LEVEL **P924**

Wood-frame, 20½-in.-long, true pitch level has aluminum adjustment that makes it easy to get the exact pitch of a pipe or drain, set that pitch, and maintain it accurately throughout the run of the pipe. In just a moment, by aid of a table on the decal attached to the device, the true pitch level can be figured and set. When the level-indicating bubble, which can be read from the top or either side, shows level, the pipe is at the proper pitch as set.

Dreier Bros, Shawano, Wis.

SPEED INDICATOR **P922**

Improved OZ hand tachometer, has a 3-in. dial single spindle quintuple selective range with a rotating gear shift. Comes in three different range combinations for speeds from 30 to 48,000 rpm or 15 to 24,000 fpm. Combined with an OZ hand tachograph, also with a 3-in. dial, gives a precision recording mechanism. Everything the tachometer indicates is recorded by the tachograph on graphic charts on a traveling paper strip.

O Zernickow Co, 15 Park Row, New York 7, N. Y.

MOTOR VALVE **P923**

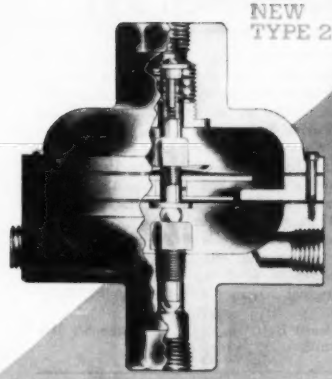
Air-operated diaphragm valves, Series 362, for on-off and narrow band proportional control, are primarily single-seated, tight-closing devices, requiring a minimum of mounting space and available in a wide variety of body materials and styles. Sizes range from ½ through 2 in., for a spring designed for tight shutoff and narrow band control, ½ through 8 in. for an on-off service. These valves operate over an air pressure range from 0 to 15 psi.

Minneapolis-Honeywell Regulator Co, Brown Instrument Div, Wayne & Windrim Ave, Philadelphia 44, Pa.

SELF-PRIMING PUMPS **P915**

Designed for easy replacement of wearing parts this self-priming centrifugal pump is guaranteed to meet capacity standards

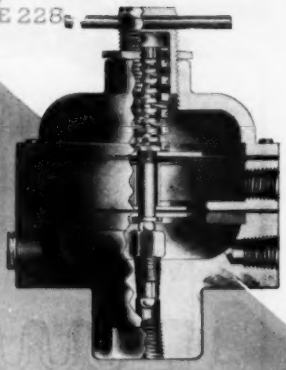
NEW
TYPE 227



A delayed action, fixed ratio relay. For use with series-operating diaphragm control valves in "split ranges". Permits full valve travel with primary control pressure changes as low as 2 or 3 pounds.

NEW
TYPE 228

Reverse action relay delivers maximum pressure output at minimum input or vice versa. No modification in either pilot or valve hook-up necessary. Or install in bypass to achieve reversal of valve closure in relation to pilot action if required occasionally.

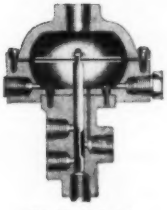


Get greater speed of action ...Install BS&B "Climax" Relays

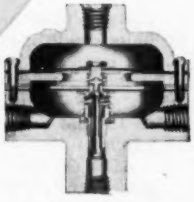
• BS&B "Climax" Relays serve as primary regulator valves to step up the action through the control of supply medium to the control valve.

The wide BS&B "Climax" line provides a variety of functions ... one-to-one, fixed ratio, variable ratio, delayed or reverse action. They may be used to load diaphragms or pistons with liquid operating medium while the control instrument loads the relay with gas. Booster action is also possible, to enable small capacity controls to handle larger duties.

Write today for the latest illustrated catalog Section 109, complete with descriptions, performance figures, installation data.



TYPE 209
1 to 1 Ratio

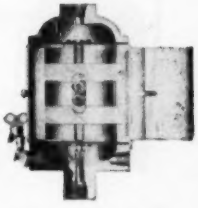


TYPE 217-4A
Fixed Ratio

BLACK, SIVALLS & BRYSON, INC.
Climax Controls Division
Adv. Dept. Room 53Q 7502 East 12th St. Kansas City 3, Mo.

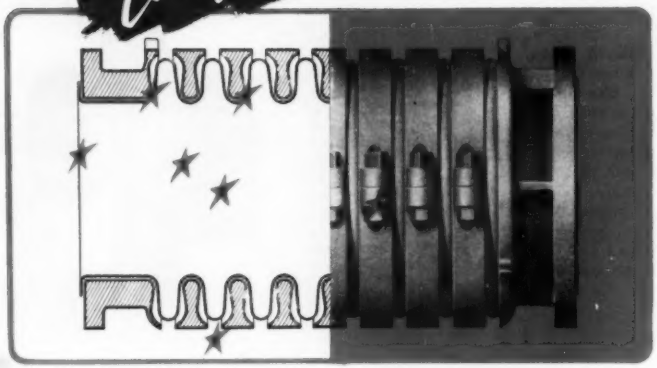
BS&B

"Climax"
RELAY REGULATORS



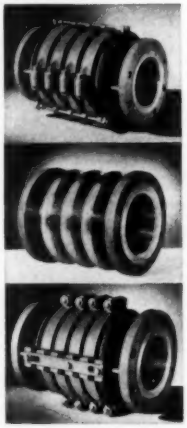
TYPE 224
Variable Ratio

ADSCO *Corruflex* is better because...



no other packless expansion joint combines ALL these features!

- **NO MAINTENANCE.** Since the corrugated element, made from a single tube of copper or stainless steel, is a flexing member designed to absorb expansion or contraction, no packing of any kind is necessary.
- **LONG LIFE.** The element is formed hydraulically to ensure uniform wall thickness. Annealing during and after forming relieves all internal strains. Flexing stresses are evenly distributed and are not concentrated at welds or diaphragms.
- **UNIFORM RAISED FACE.** Element is hydraulically lapped over the end flange to form smooth, even face for joining to mating pipe flange.
- **EQUALLY DISTRIBUTED EXPANSION.** Equalizing rings of cast iron or steel control individual corrugation expansion and reinforce element walls.
- **STURDY CONSTRUCTION.** Heavy lugs and rings are cast in a single piece, accurately machined into halves and kept in pairs to ensure a tight joint.
- **COMPLETELY SUPPORTED ELEMENT.** Both end flanges and rings are contour shaped, scientifically designed to support element throughout its entire length. All inner surfaces are carefully hand-finished.
- **COMPACT.** Maximum outside diameter is only slightly larger than that of the flanges. Ideal for installation in cramped quarters.



Corruflex Joints are available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings, and with flanged or welding ends. Supplied in copper, stainless steel or other alloys and with internal sleeves if required.

Corruflex Joints have traverses ranging from fractions of an inch to 15" and operate under pressures from vacuum to 300 psi and temperatures from sub-zero to 1600F.

ADSCO offers the most complete line of expansion joints—both packed and packless—available from any manufacturer. For an impartial recommendation, consult the company that makes all types.

Send for New 16-page Bulletin No. Z-35-51

Explains design and construction and completely describes the line . . . sizes, temperature and pressure ratings, dimensions and weights. Simplified selection charts make it easy to determine proper joint for most applications. Recommended installation practice is summarized.

Expansion Joints
Steam Traps · Meters
Anchors · Guides

ADSCO Since 1877

Heat Exchangers
Strainers · Separators
Casing · Supports

AMERICAN DISTRICT STEAM COMPANY, INC. • North Tonawanda, N.Y.

More EQUIPMENT NEWS

Begins on page 154

of the Contractors Pump Bureau of the Associated General Contractors of America. Removal of a cover plate makes it possible to replace or adjust practically all the wearing parts in the pump.

Sizes range from 1½ to 6 in., and capacities from 70 to 1500 gpm. High-carbon steel air peeler and open type impeller assures maximum water-handling capacity. When abrasive wear on air peeler or impeller destroys original clearances and pump priming, efficiency can be easily restored by adjusting the clearance to its original tolerance with the impeller. Bulletin No. 51-27 available.

Chain Belt Co, 1600 W Bruce St, Milwaukee 4, Wis.

For more data on these items, use post cards, p163. Identify request with P and number.

END SEAL **P925**

Inexpensive moisture seal for terminating multi-conductor, sheathed-cables has a cone shape to receive filling compounds. Easily and quickly slipped over the cable to eliminate the need for friction tape or makeshift winding. It is applicable to cable diameters from ⅜ to 2 in., and snugly fits over the cable sheath to prevent compound leakage. The compound hardens to form a permanent moisture-proof seal and keeps the conductors properly spaced.

Okonite Co, Passaic, N. J.

VERTICAL SUMP PUMPS **P917**

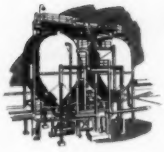
Four basic units are available in sizes from 1- to 10-in. discharge, 10- to 3000-gpm capacity and heads up to 140 ft. Pump has standard fluid ends but can have fluid ends for handling sewage in the 2- 3- and 4-in. sizes. They are driven by ½- to 75-hp motors or by steam turbines.

Guide-bearing assemblies are interchangeable as intermediate or bottom bearings. In the thrust-bearing assembly the lower-half coupling fits accurately into the bore of a large-capacity contact radial thrust ball bearing.

Shaft has hard stainless-steel sleeve through bottom guide bearing and motor-support shaft-seal assembly. Semi-open impeller can be adjusted vertically with shaft

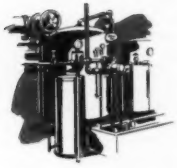
5 WAYS TO → SOFT, CLEAR, PURE WATER

. . . for Power Plants

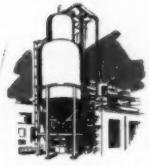


1. SLUDGE BLANKET HOT LIME SODA. *Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.*

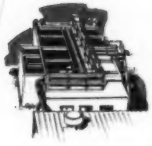
2. HOT ZEOLITE—PERMUTIT Q. *Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, a styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.*



3. SILICA REMOVAL PLUS DEMINERALIZATION. *Demineralization by cold ion exchange processes produces water comparable to distilled water at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.5 ppm.*



4. DEAERATING HEATER. *The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers, by removing oxygen and free CO_2. Capacities from 12,000 to 1,400,000 pounds per hour are in service.*



5. PRECIPITATOR. *The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.*

These basic processes, plus Permutit skill—can solve your water conditioning problem

Other processes include mixed bed demineralization and cold zeolite water softening. Whatever your problem, Permutit has equipment to solve it. Write for free information to The Permutit Company, Dept. P-9, 330 West 42nd St., New York 18, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

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Oxy-acetylene welding is a lot safer and faster today because of a unique hose called Twin-Weld.® Invented and patented* by Hewitt-Robins, it does away with the dangerous tangle of individual oxygen and acetylene lines that formerly plagued welders.

Twin-Weld combines both hoses in one compact, molded unit . . . neat, flexible, non-kinking . . . yet readily separates for coupling to tanks and torch. It saves time in getting welding equipment into operation, makes it easy to reach the work, change position at will or work in close quarters on difficult jobs.

Making better industrial hose and belting has been a habit at Hewitt-Robins for almost a century. Twin-Weld is only one of many Hewitt-Robins "firsts" that have made the handling of fluid and solid bulk materials faster, more dependable, more efficient, more economical.

If you want the benefit of an international experience in solving your materials handling problem . . . whether in hose, belting, vibrating machinery or complete belt conveyor systems . . . get in touch with Hewitt-Robins.

*U. S. Patents 2,122,355 & 2,136,220

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HEWITT RUBBER DIVISION: Belting, hose and other industrial rubber products
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Hewitt-Robins is participating in the management and financing of Kentucky Synthetic Rubber Corporation

More EQUIPMENT NEWS

Begins on page 154

and is mounted on it with locking taper, key and safety nut. Duplex units can have alternator float switch to operate each pump in sequence, or both together, as required. Bulletin No. 4600-A available.
The Deming Co, Salem, Ohio.

For more data on these items, use post cards, p163. Identify request with P and number.

OSCILLATING CONVEYOR P919

An oscillating trough conveyor handles many kinds of loose materials, such as food stuffs and chemicals where cleanliness, contamination or corrosion is a factor. Also hot, sharp, jagged or oily material, like steel chips and turnings are handled with practically no wear on metal trough. Escape of dust or gas is prevented by a metal cover and flexible connection at loading and discharge points.

A one-piece metal trough supported on simple one-piece flexible members which act as springs. The trough is oscillated by a roller-bearing constant-stroke eccentric. Troughs are normally 4 in. deep, and are made in standard widths of 8 to 24 in. of No. 10 to 12 gage steel, corrosion-resisting steel and other materials in lengths up to 100 ft. Dividers can be put in the troughs to convey several materials at the same time. Discharge is possible at any desired point. Bulletin No. 2378 available.
Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

MERCURY SWITCH P941

Single-pole, double-throw type switch, 4-2 KRI, gives a mercury-to-mercury contact when the electrical circuit is cut off. Advantage of this contact is that there are no fixed metal points in the circuit to wear away.
General Electric Co, 1 River Rd, Schenectady, N. Y.

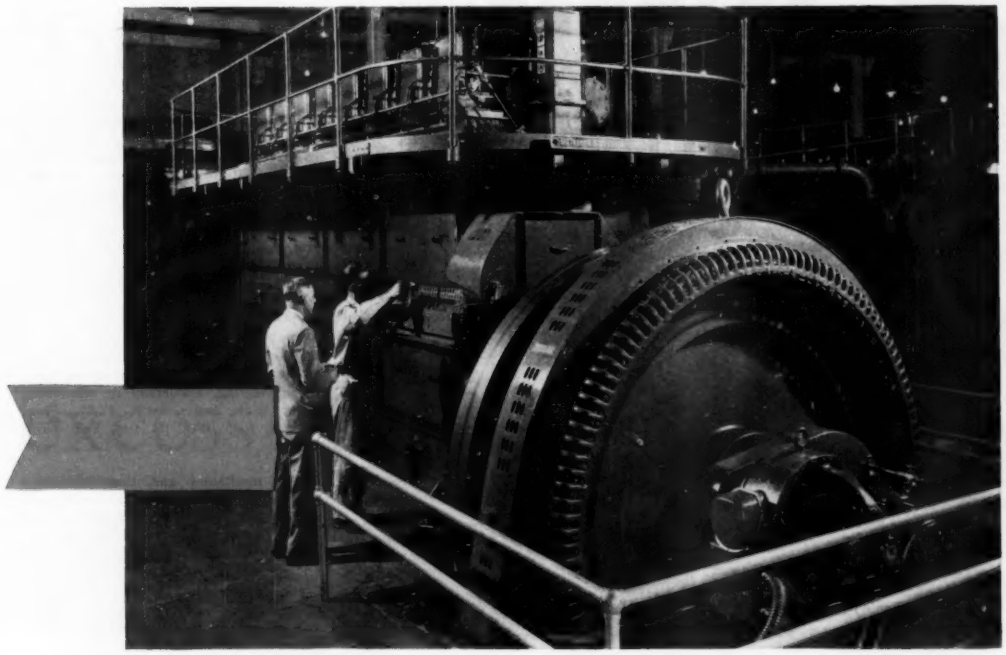
TIME-DELAY RELAY P950

Silic-O-Netic time-delay relay, has only one moving part in the time element. It is hermetically sealed and never needs attention. Over-all dimensions of the entire relay are $1\frac{5}{8}$x$2\frac{1}{2}$x$\frac{3}{4}$ in. It is rated 10 amp at 120-v ac.

Sealed tube extends through and below the relay coil. Tube is filled with a viscosity-stable silicone liquid and holds a movable iron core. When the coil is energized, the movable core is drawn up into the magnetic field, but the rate of rise is controlled by the silicone liquid.
Heinemann Electric Co, 371 Plum St, Trenton 2, N. J.

Is there room for improvement in your Diesel engine lubrication?

—call in a GULF LUBRICATION ENGINEER



There's no better source of help on any problem that involves lubricants, lubrication, or maintenance of stationary Diesel engines than a trained Gulf Lubrication Engineer.

Gulf Lubrication Engineers are experts in petroleum technology—they are familiar with refining processes, additives, and the past performance records of various types of lubricants. They completely understand the effect of different operating conditions on lubricants. And, just as important, they know the lubrication requirements of all types of Diesel units and auxiliary equipment.

The application of this knowledge and experience to each individual problem helps reduce maintenance costs for power plant equipment.

To get the benefits of this expert engineering service for your plant, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pennsylvania.

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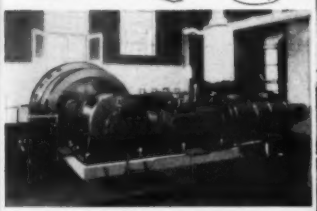
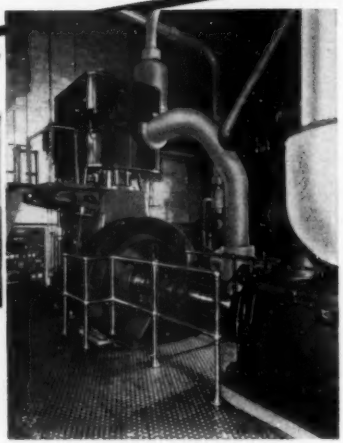


300-Kilowatt Horizontal "Universal Unaflow" in Meat Packing Plant.



Two-cylinder "Universal Unaflow" driving ammonia compressor, in Brewery Power Plant.

Hundreds of companies whose products are as diversified as milk, baked goods, candy, canned foods, meat products, and beer, have this in common . . . they require economical, unfailing power; they require steam for processing; they require steam for heat.

A SKINNER "Universal Unaflow" Engine installation gives them all three . . . abundant power produced by man's most economical prime mover . . . exhaust steam for utilization in processing . . . exhaust steam for space heating.

Food processing companies all over the United States and in many foreign countries have been depending on SKINNER "Universal Unaflow" Steam Engines for four decades . . . and as their operations are expanded, proved performance naturally leads to additional SKINNER Engine installations.

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More BOOKSHELF

Begins on page 166

SERVOMECHANISMS AND REGULATING SYSTEM DESIGN, *Vol I (1951). By H Chestnut and R W Mayer, aeronautics and ordnance systems div, General Electric Co. 505 pp, illust, 6x9¼, $7.75. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Intended for training design and application engineers, the book starts from basic mathematics to describe physical problems involved and shows how to solve advanced problems. Feedback control concept for regulators and servomechanisms is emphasized. Throughout, the book uses the nomenclature and symbols recommended by the AIEE Feedback Control Committee.

Differential equations and Laplace transform methods are used to solve transient problems. The importance of stability is stressed in the many typical systems illustrated. Analysis and synthesis of multiple loop and multiple input systems met in practice are studied from the attenuation point of view. Dynamic as well as static error coefficients are given in the practical approach to system synthesis. The book includes charts, showing nature of design characteristics needed to get desirable steady-state and transient responses.

THERMODYNAMICS OF FLUID FLOW *(1951). By Newman A Hall, professor of mechanical engineering, University of Minnesota. 278 pp, illust, tables, 6x8¾, $7.35. Prentice-Hall, Inc, 70 Fifth Ave, New York, N. Y.*

Fluid mechanics and thermodynamics form two foundation stones of mechanical engineering. While they are usually treated separately, the present-day development of practical machines has shown that using both as a combined field has considerable advantages in design of practical equipment. This book contributes to understanding the close relationship between the two.

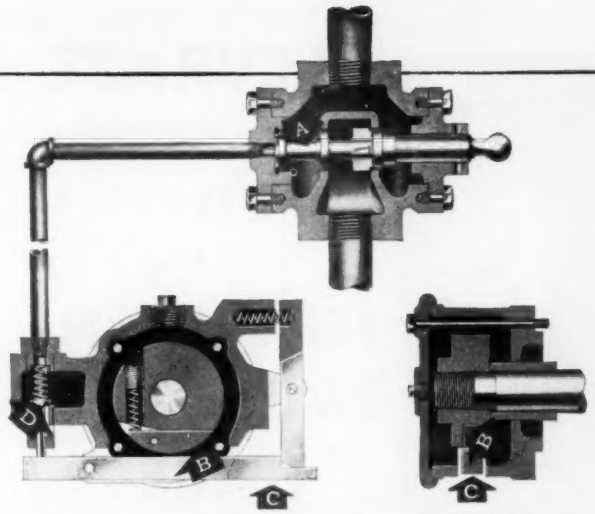
The emphasis is placed on theory, assuming the reader has had basic training in both fields. Examples demonstrate application of theory to practical problems. The book develops the combined fields on the basis of one-dimensional steady flow. Most internal flow analysis can be made on this basis in at least a preliminary way.

Various flow losses such as wall friction and turbulent separation are studied from the viewpoint of dynamics and energy as internal entropy increases. A common basis for flow losses is made by establishing coefficients for entropy and different losses. While this material is in text form, it will also serve as practical reference material for engineers in research and development of propulsion, process industries and other fields depending on flow systems.

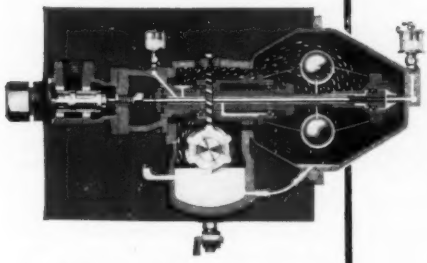
AIRCRAFT JET POWERPLANTS *(1951). By F P Durham, asst professor, Aeronautical Engineering, University of Colorado. 326 pp, illust, charts, 6x8¾, $6.65. Prentice-Hall, Inc, 70 Fifth Avenue, New York, N. Y.*

For undergraduate engineering students

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

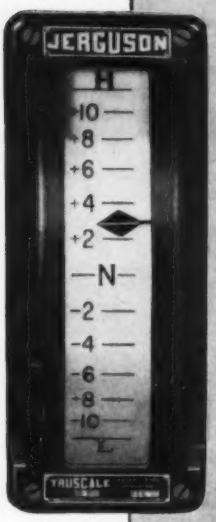
CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

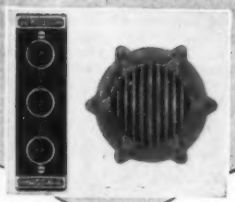
COPPUS ENGINEERING CORPORATION, 169 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES



ACCURATE

Liquid Level Readings AT REMOTE POINTS with the JERGUSON TRUSCALE GAGE



Available with Visible and Audible Alarms and Repeaters at auxiliary points.

THE Jerguson Truscale Gage reproduces your boiler water, deaerating tank, or other liquid level at remote points with accuracy as close as ½ of 1%. This is made possible by a design which transmits movement changes in a mercury-filled manometer through a specially designed featherlight pointer system. A unique magnetic coupling, with a magnetically energized yoke operating on precision bearings, uses the maximum of coupling force available with a minimum of inertia in the pointer system.

The extreme sensitivity and close accuracy of the Jerguson Truscale Gage gives you *dependable liquid level readings at remote points.* The Truscale Gage has a built-in adjustment for easy calibration for any W.S.P. The dial is illuminated, the scale markings and pointer glow in the dark, and the gage is available with visible and audible alarms.

Investigate this exceptional remote reading liquid level gage. Write for data unit on Jerguson Truscale Gage.

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More BOOKSHELF

Begins on page 166

who have a knowledge of elementary thermodynamics and fluid mechanics. The first six chapters cover the principles of gas turbines and jet propulsion. The next five study components of jet engines, such as inlet diffuser, compressor, combustor and jet nozzle. The last two chapters cover the fundamentals of ramjets and rockets.

Compressible gas flow theory is developed throughout the book as it's needed to outline the subject. Friction is discussed in relation to inlet diffuser process, heat addition in relation to combustors, shock waves in relation to ramjet inlets. Photographs show the physical appearance of various types of jet engines.

THE NATURE OF POLYPHASE INDUCTION MACHINES. *By Philip L Alger, consulting engineer, small and medium motor div, General Electric Co, 6x9 in., 397 pp, $7.50. John Wiley & Sons, Inc, 449 Fourth Ave, New York 16, N. Y.*

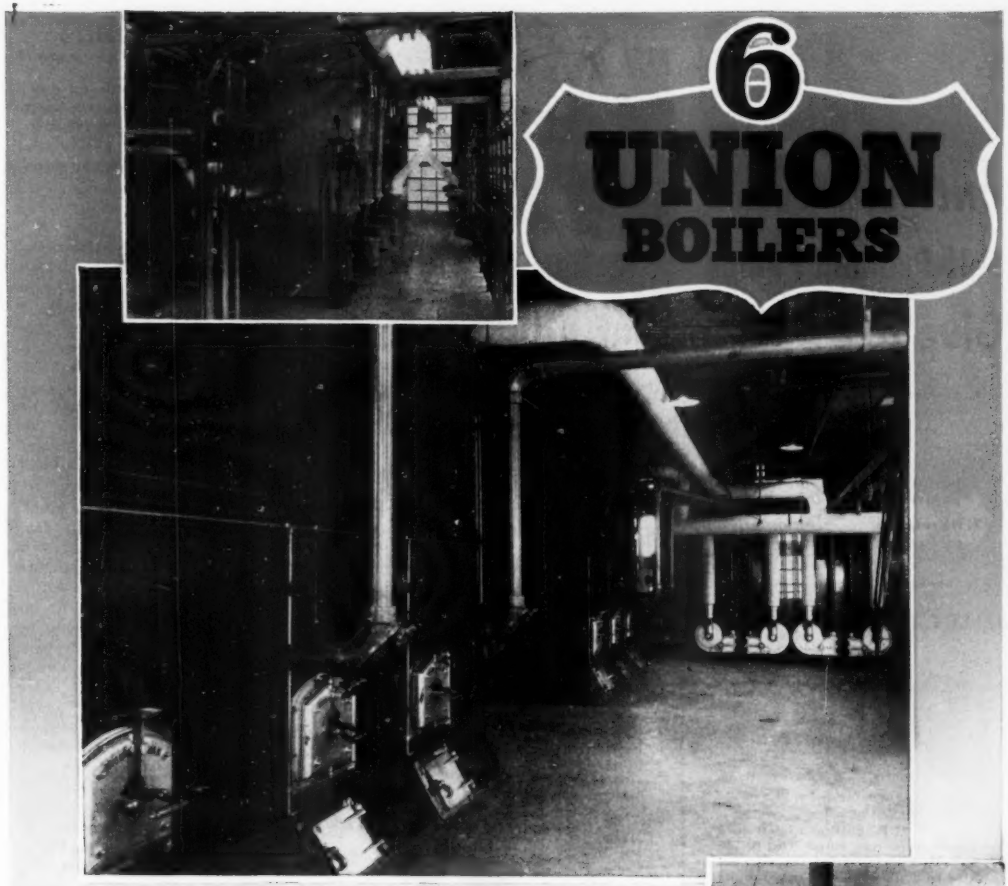
Through liberal use of mathematics (actually the author's analysis starts from the college sophomore level of mathematics and physics), the concept of energy being received, stored, transformed and delivered in the induction motor is well developed. Complete and accurate formulas are given for reactance, power factor, torque and magnetic forces; methods for calculating locking, crawling, magnetic noise and voltage ripple. Results are presented in algebraic formulas and equivalent circuits with few symbols. Adequate reference is made to more specialized tables.

Performance calculations for the induction motor are well covered in chapter 5. Here the subject is introduced with the equivalent circuit and discussed for standstill conditions and when the motor operates in the region of full load. An analysis is made with generator operation foremost in mind.

REVIEW OF CURRENT RESEARCH AND DIRECTORY OF MEMBER INSTITUTIONS (1950). *By Engineering Research Council, American Society for Engineering Education. Edited by J I Mattill, Mass. Institute of Technology. 244 pp, paper cover, 6x9, $2.25. Engineering College Research Council, Rm 7-204, 77 Massachusetts Ave, Cambridge 39, Mass.*

There are more than 5200 engineering research projects, costing annually over $50,500,000, now active in U.S. engineering schools. This book outlines the policies and research activities in 91 schools. It gives brief digests of research projects and contracts, number of personnel, annual expenditures, special conferences and short courses of interest to research workers.

Schools are arranged in alphabetical order throughout, making them easy to find. A 28-page index at the back enables finding schools doing particular kinds of engineering research.



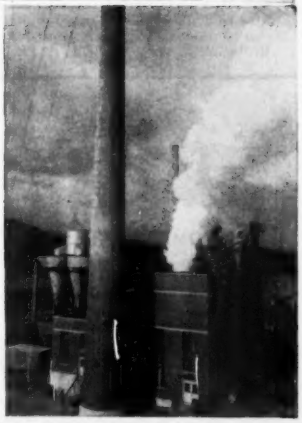
6 UNION BOILERS

Serve BASSETT FURNITURE INDUSTRIES INC.

SIX Union 2 Drum Type "VO" Steam Generating Units having a capacity of 40,000 pounds of steam per hour each, furnish steam for power and process for 3 divisions of Bassett Furniture Industries Inc.

These units are of a special design for burning kiln dried wood refuse under fully automatic control.

The furnace and firing equipment burns coal during periods when wood refuse is not available.



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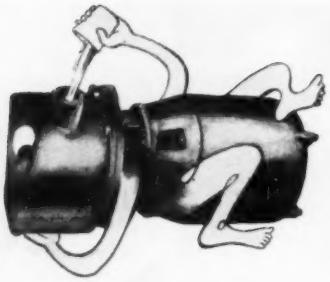

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1. **Absolutely no valves**—There are no valves of any kind in these pumps—nor are any needed in installation. Liquid can drain out of discharge and suction line through pump without affecting priming ability.
2. **No recirculation**—Liquid does not recirculate after completion of priming action.
3. **Top-notch efficiencies**—Efficiencies in these pumps are comparable to quality straight centrifugal pumps.
4. **Positive fast-acting self-priming**—Self-priming is similar to priming ability of positive displacement pumps.
5. **Small compact priming chambers**—No large or bulky priming chambers mean small, compact units at low cost.

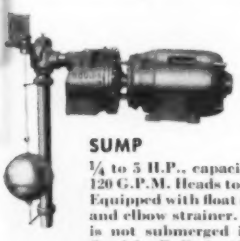
SELECT THE PUMP YOU NEED FROM THIS COMPLETE LINE

INDUSTRIAL

¼ to 5 H.P. ratings, open and closed impellers. Capacities to 120 G.P.M. Heads to 135 ft., suction lifts to 25 ft. Flexible coupling, or close-coupld motor drive. Send for Bulletin 636.1.

PORTABLE

Compact, lightweight, with gasoline engine. Capacities to 58 G.P.M. Heads to 25 ft. Send for Bulletin 639.1.



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¼ to 5 H.P., capacities to 120 G.P.M. Heads to 135 ft. Equipped with float switch and elbow strainer. Pump is not submerged in pit. Send for Bulletin 627.

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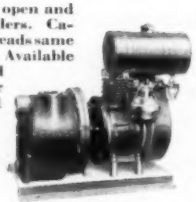
1½ to 5 H.P., open and closed impellers. Capacities and heads same as Industrial. Available in close cupld only. Send for Bulletin 638.1



For complete information contact your nearest Goulds representative or write Pump Headquarters, Seneca Falls, N.Y.

MEMBER

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More TECHNICAL BRIEFS

Begins on page 150

point for this project. With few exceptions, some overheated parts, such as a seized piston, connecting rod, bearing, were the source of ignition. Several reports on these crankcase explosions indicate an initial explosion, with enough energy to force off crankcase doors, is immediately followed by a second of greater intensity. This second explosion spreads burning oil throughout the engine room. The increased intensity of the secondary explosion is explained generally on the basis that the initial explosion took place in a slow-burning "rich" oil-air mixture. Cooling of the primary explosion gases causes an inrush of air through the blownout crankcase opening so that enough air gets in to re-form a "leaner," more explosive mixture for the secondary explosion.

Experimental tests indicate the crankcase atmosphere is a potentially flammable mixture of oil mist and air in which ignition can easily be initiated by an overheated part. The minimum ignition temperature is reduced by decreased air flow, increased mixture temperature, and increased igniter size. No significant differences were found in minimum ignition temperature of a wide variety of lubricating oils, even when diluted with up to 20% diesel fuel.

As long as flammable lubricants are employed, it seems little can be done from a lubricating-oil or fuel standpoint to prevent crankcase explosions. The authors feel the problem may best be attacked by further critical studies of operation and maintenance practices and continued refinements in engine design. *ASME paper No. 51-OGP-2.*

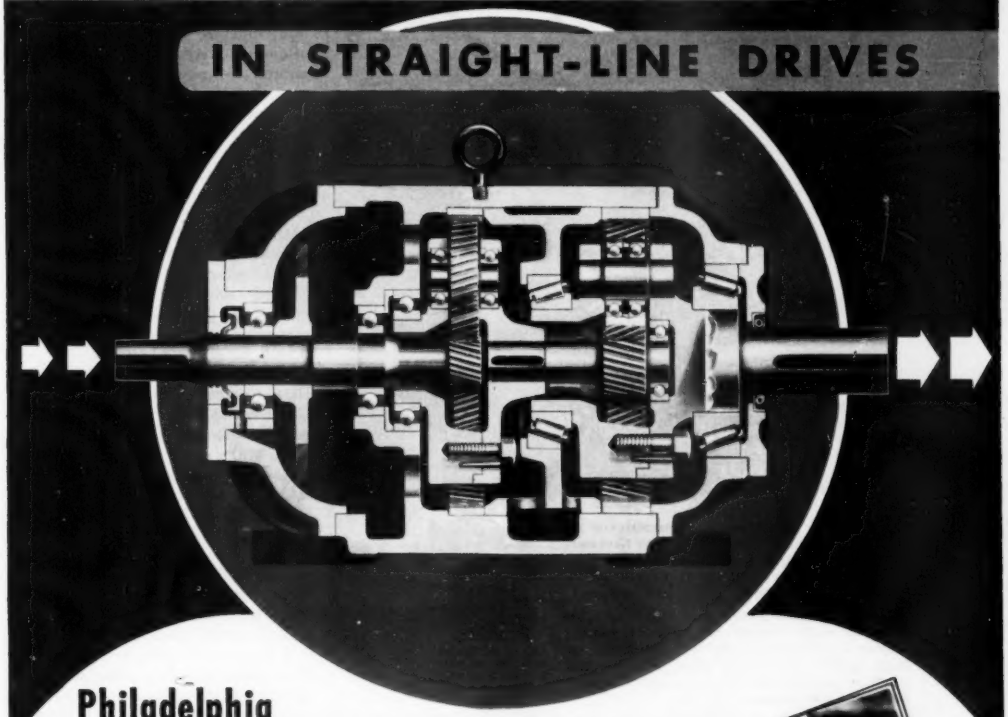
Directions for ordering papers on p 152

DAMAGE PREVENTION FROM DIESEL ENGINE CRANKCASE EXPLOSION, *by A C Cavileer, U. S. Naval Engineering Experiment Station.* The Navy's approach to the problem of diesel engine crankcase explosions is primarily to try to maintain and operate its engines as carefully as possible. Then, it attempts to contain the explosion and limit or prevent as much as possible the effects of the explosion and fire which sometimes follow by providing adequate facilities for protection of personnel and surroundings. Many diesel manufacturers have investigated these explosions but most seem to feel that to publish their results might be a confession that their engines are particularly susceptible to explosion.

The Navy has carried on a number of tests in an effort to minimize the effect of these explosions. Their tests

THE ULTIMATE

IN STRAIGHT-LINE DRIVES



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PLANETARY SPEED REDUCERS

Where a separate, "straight line" reduction drive is preferred . . . The Philadelphia Planetary Reducer is *the answer* . . . this unit is distinctly superior to old style Spur Gear Reducers, and has many advantages over parallel shaft reducers . . . Input and output shafts are "in line", which greatly simplifies the base plate design and improves the appearance of the complete drive. Another point . . . The Philadelphia Planetary Unit is extremely compact and designed for continuous, rugged service—and is Dust, Dirt, Moisture and Fume-proof. Housings are oil-tight and all units carry "official" A.G.M.A. Rating Tag. For overload protection, they may be equipped with the "exclusive" Philadelphia PlaneTorque Control. Units are available for drives up to 140 horsepower and in ratios up to 106.1 to 1.

Write on your Business Letterhead for Bulletin 100.

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Industrial Gears and Speed Reducers
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Proper Drainage!
STORAGE WATER HEATER
STRAINER
STRAINER
Strong 80 Series Trap (1) with Strong Thermal Air Valve By-Pass (2) insures quick drainage of accumulated condensate and rapid starting. Strong 70 Series Trap (3) drains inlet line, maintaining dry steam at temperature regulating valve.

PROBLEM: Condensate accumulates in coils due to lack of pressure when thermostatic regulating valve is throttling or closed. *Improper drainage and water hammer result when thermostatic valve opens.*

SOLUTION: *Drain coils fast.* Use trap with four to eight times capacity of actual steam condensate rate. For medium or high pressures, either open or inverted bucket traps are suitable. *Use open bucket traps for low pressures.*

Completeness of the Strong trap line enables our engineers to recommend exactly the type or size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc., forged, welded, cast or semi-steel construction. Bring your drainage problems to us for solution. Send for Strong Trap Catalog No. 68-P today for complete details of *all* Strong traps.

Strong 80 Series Trap for medium or high pressures.

Strong 30 Series Trap for high, medium or low pressures.

STRONG, CARLISLE & HAMMOND COMPANY
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More TECHNICAL BRIEFS

Begins on page 150

divide into two categories: (1) tests of explosion-relief-type doors designed to relieve initial explosion pressures and thereafter seal the crankcase from inrush of fresh air (2) tests of flame-type doors to withstand the pressures of a crankcase while other relief means of operating are put in effect to prevent an excessive pressure rise in the crankcase.

Results of these tests show that several otherwise satisfactory door installations prove ineffective in providing protection against explosion. The most serious deficiencies have been in the method of securing the door to the engine and the method and materials used for the gasketing between door and door opening.

Paper describes the test setup, a number of the tests run, and several conclusions resulting from these tests. *ASME paper No. 61-OGP-3.*

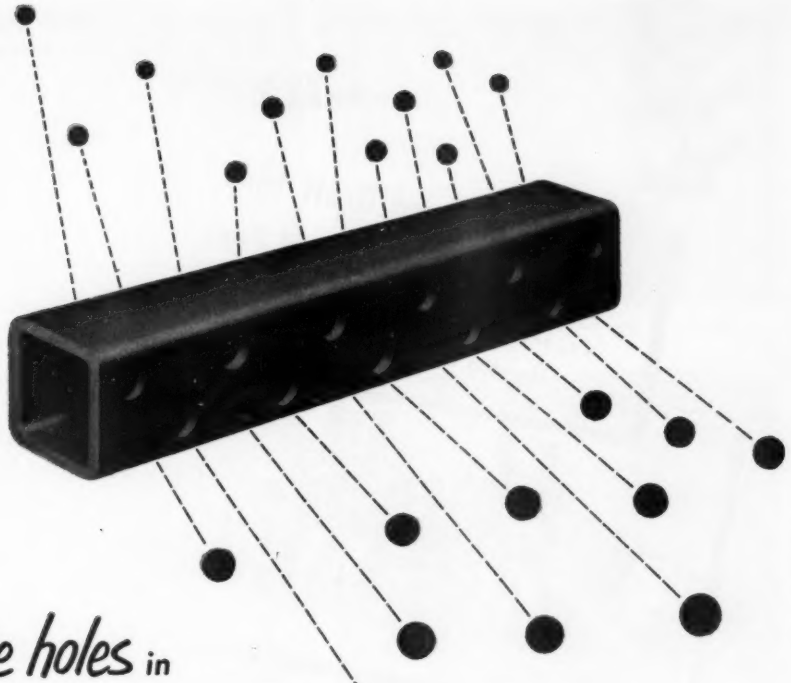
DESIGN OF THE EXHAUST SNUBBER FOR GAS ENGINES, *by R L Leadbetter, Burgess-Manning Co.* The exhaust snubber must withstand explosion forces involved in gas-engine service, and there is a limit to the allowable weight of the unit. Since the gas is dry and no corrosion allowance is required, there is no justification for building exhaust snubbers like pressure vessels. The author describes a number of experiences with gas explosion mixtures and tells something about their behavior.

A number of slides are provided to show what happens to a snubber on the negative path of an explosion cycle. This appears to be the only case on record when a snubber actually collapsed as a result of a vacuum. Further slides show the effects of a long series of exhaust explosions and means for reinforcing certain areas. *ASME paper No. 51-OGP-1.*

Directions for ordering papers on p 152

WATERCOOLING EQUIPMENT FOR DIESEL AND GAS ENGINES, *by H P Degler, The Marley Co.* It is impossible to set up any recommendations that would definitely establish selection of a given cooling method as the most suitable for any particular application. The anticipated performance, operating features, and ease of maintenance of any proposed installation should be completely analyzed. Final selection then becomes a matter of engineering compromise and personal preference.

Selection of the most feasible cooling method becomes more important as industries expand and processes are perfected. Water has always been considered a convenient cooling source. But



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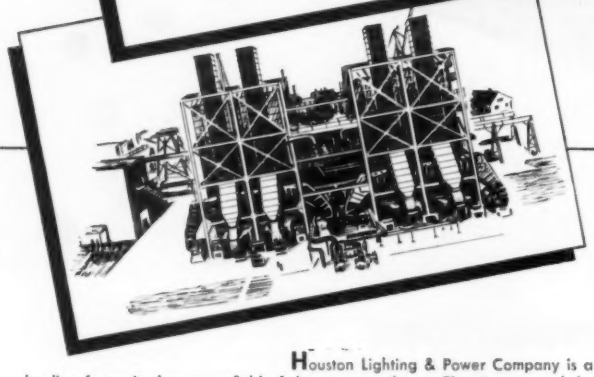

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More TECHNICAL BRIEFS

Begins on page 150

since the demand for water has more than doubled in the past ten years and underground sources in many areas are dangerously depleted by overuse, water's use must be evaluated at a price.

The author then describes the various methods of cooling employed by industry, starting from the early use of rivers, lakes, wells and cooling ponds through spray ponds, evaporative coolers, natural-draft cooling towers, forced-draft cooling towers, to induced-draft cooling towers, and air-cooled heat exchangers. Progress of the cooling-equipment industry is indicated by the fact that a modern cooling tower or dry-gas surface cooler requires only 1 sq ft of ground area compared to about 50 for a spray pond and a thousand for a natural cooling lake.

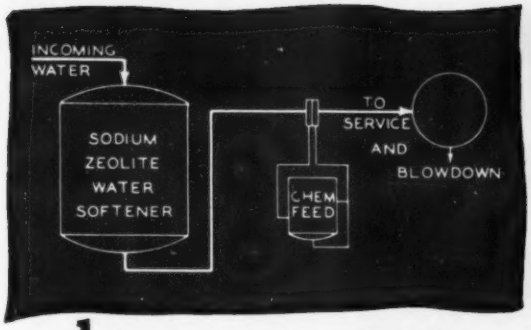
The author discusses the operation of cooling towers and air-cooled heat exchangers. Finally, he discusses engine-cooling systems and the application of the cooling equipment described above. Information is also furnished on operation and maintenance, including water treatment for scale and algae control. *ASME paper No. 51-OGP-6.*

Directions for ordering papers on p 152

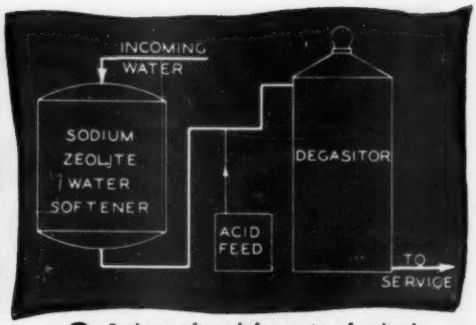
Heating and Piping

STEAM-GENERATING STATION AS A SOURCE AND SINK FOR THE HEAT PUMP, *by J A Eibling and B A Landry, Battelle Memorial Institute.* Realizing the great potentialities the heat pump offers, electric utilities and a number of manufacturers have invested in the last two years alone about one million dollars in at least 25 research projects on the heat pump. Principal problem is providing a suitable heat source. This holds especially for northern localities where the maximum heating load runs about twice the maximum cooling load. The ideal solution is one where: (1) size of compression-refrigeration unit is also adequate for heating the house (2) total cost for heating with electric energy available at average prices compares with those of automatic heat.

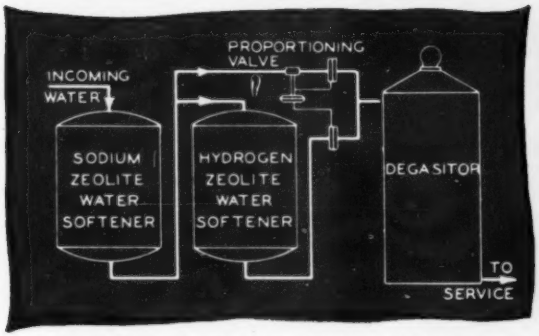
Residential summer cooling can be expected eventually to become a part of our standard of living. The system described in this paper, where a steam electric generating station is used as a source and a sink of heat for heat pumps, requires for any practical application an extended decentralization of stations and a considerable decrease in installed capacity in comparison with large stations of the present day. *ASME paper No. 51-A-16.*



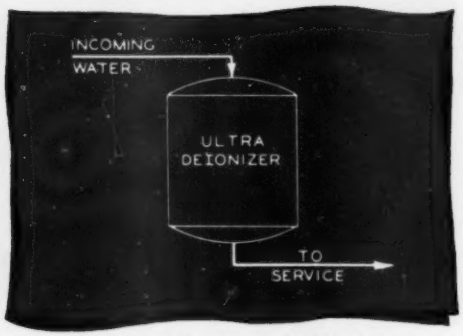
1 Gives soft, scale-free water — prevents corrosion.



2 Produces soft, scale-free water of reduced alkalinity.



3 Delivers soft, scale-free water. Reduces alkalinity to desired level and gives marked reduction in total dissolved solids.



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Begins on page 150

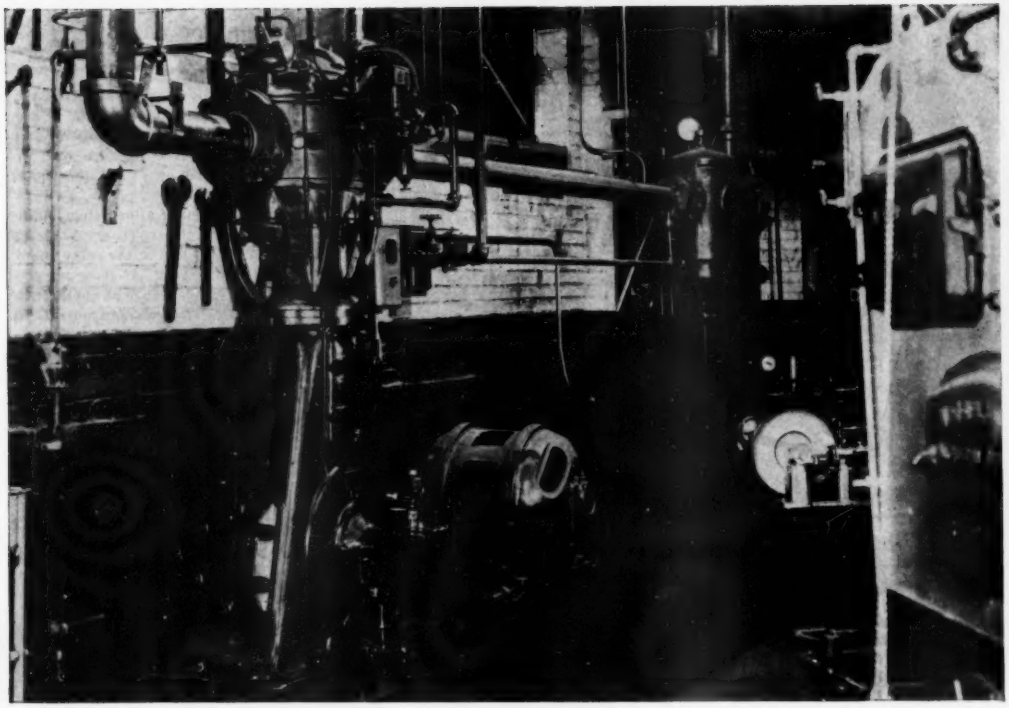
THE APPLICATION OF OXYACETYLENE PROCESSES IN PIPE FABRICATION, *by E P Auler, Taylor Forge & Pipe Works.* Since a majority of pipe fabrication takes place on ferrous materials, the use of the oxyacetylene cutting torch provides a convenient and readily portable means for cutting and shaping the steel at low cost. Further, the oxyacetylene method of gouging gives a rapid and economical means of forming U-shaped grooves by removing surface or edge metal. Lastly, as a means of heating, the combustion of about equal volume of oxygen and acetylene gives a flame far hotter than that of any other known gas flame, somewhere around 6000 F. So this means of heating serves as a convenient source for a wide variety of operations in pipe fabrication, such as forming, bending, straightening, preheating and postheating of weld operations.

The author goes on to discuss the various general applications of the three essential features of cutting, gouging, and heating outlined above. In addition, a number of special applications of the oxyacetylene process are given. Presented before the International Acetylene Assn, Windsor Hotel, Montreal, Quebec. *Available through International Acetylene Assn, 30 E 42nd St, New York, N. Y.*

Directions for ordering papers on p 152

Materials Handling

PROBLEMS ARISING IN STORAGE AND HANDLING OF PULVERIZED MATERIALS, *by F Silzer, Martinsburg, W. Va.* Engineers generally do not deal properly or correctly with imperfect fluids. One major reason is that all their school-level training is in the handling of perfect fluids. The author suggests the following steps to correct this condition: (1) Development of a general theory of flow of perfect and imperfect fluids by adding time as an additional parameter for thixotropic materials. (2) Extension of the term thixotropy to include any material whose yield point increases with time for any reasons whatsoever. (3) More emphasis on quantifying changes in yield point and flow characteristics of imperfect fluids, especially at very low flow rates, and making this information available in engineering handbooks. (4) Restricting the term dilatancy for flow rates to non-Newtonian fluids. (5) Developing a theory relating flow characteristics of granular material to frictional characteristics between particles. *ASME paper No. 51-SA-45.*



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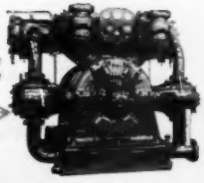

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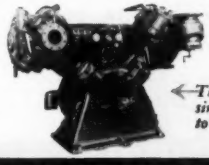

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ELECTRONICS

Continued from page 91

1*B*. Since outside temperature remains constant, voltage curve AB_1C is the same in Fig. 1*B* as in 1*A*. Dotted curve AB_2C, the difference between the two is the minus bias on T_1 and the signal that turns off the heat.

When this signal, after being amplified, decreases the volts across relay coil *CR* to 25 v, Fig. 2, the relay opens and turns off the heat. As room temperature decreases resistance of the thermostats decreases and voltage from *RG* to N_2 increases to approach curve *ABC*, Fig. 1*A*, to increase the voltage on the relay coil. When this voltage increases to 45 v, the relay's contacts close to turn on the heat. The control system, therefore, operates on a voltage differential of 45–25=20 v. Amplification of the signal voltage is such that a 0.6 ohm net change in bridge resistance will turn on or off the heating system.

Outdoor Temperature. If outdoor temperature falls, control point of the system shifts automatically to raise room temperature slightly, to compensate for a decrease in wall temperature. Let's see how this is done. When outdoor temperature drops, resistance of compensator R_5 decreases and causes a small decrease in voltage from *R* to N_2. Let curve AB_1C, Fig. 1*C*, represent this voltage. To turn on the heat when the outside temperature drops, the bridge must be in balance as before the temperature changed. So the voltage from *RG* to N_2 must equal that from *R* to N_2. Since the voltage from *R* to N_2 decreased, it must do the same from *RG* to N_2. To get this, room temperature must be a little higher to increase the thermostats' resistance slightly. Voltage then increases slightly across the thermostats and decreases from *RG* to N_2, to make curve *ABC* equal AB_1C, Fig. 1*C*, to put the bridge in balance and turn on the heat.

To turn off the heat we will need the same grid bias, on T_1 as before the outside temperature changed. To get this bias the thermostats will have to heat to slightly higher temperature, to reduce the voltage across resistors R_{15}, R_{16} and R_{17}. What has happened is shown in Fig. 1*D*. Voltage from *R* to N_2, curve AB_1C, is the same as in 1*C*, but curve *ABC* is equal to AB_1C less the signal volts AB_2C. Here we see how a decrease in outside temperature slightly raises inside temperature at which the thermostats turns on and off the heat.

A change in temperature of cycler element H_2 has the same effect in turning on and off the heat as does a change in temperature on the thermostats. Action of the cycler combined with that of the thermostats holds room temper-

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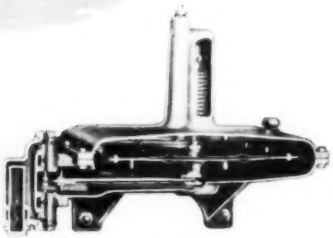

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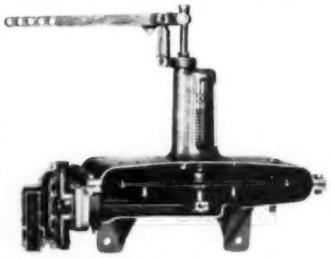
This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



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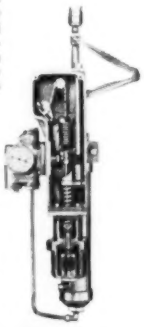

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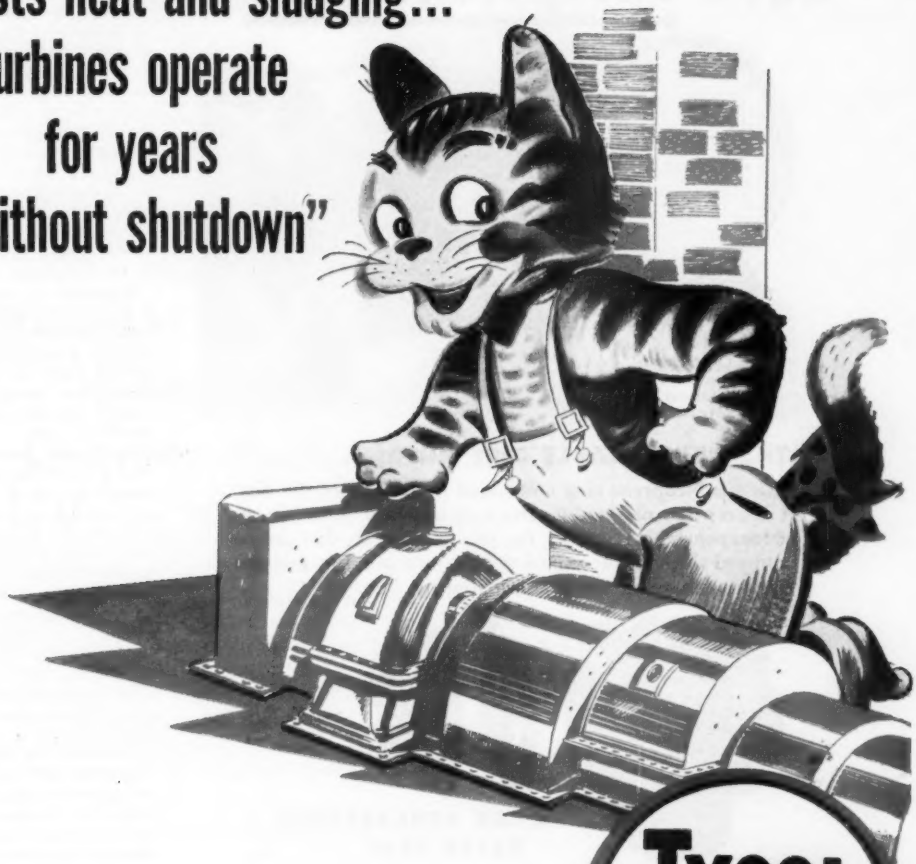

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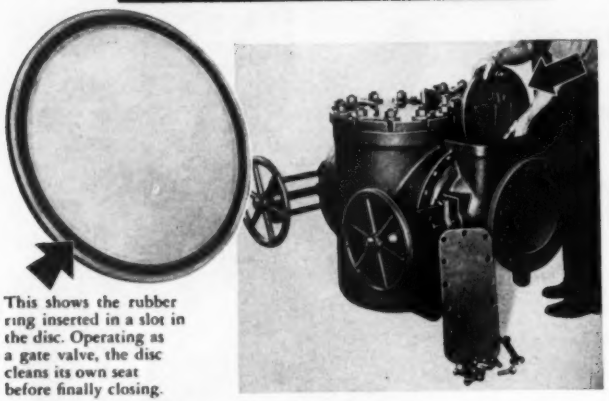

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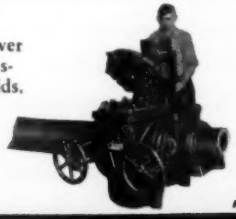

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ELECTRONICS

Continued from page 196

ature to within about 0.5 deg F, compared to 2 deg for a bimetal thermostat. How this is done will be explained later.

System Operation. Let's again turn our attention to Fig. 2 and see how the complete control operates. Tubes T_1 and T_2 form a 2-stage amplifier, and T_3 is the third stage of the amplifier and power tube for relay coil CR. Rectifier tube T_4 in combination with capacitor C_5 supplies dc to the amplifier circuits. T_1 and T_2 are parts of the same tube as are T_3 and T_4. Secondary S_3S_4 heats the cathodes of the four tubes. Cathode heaters of tubes T_1 and T_2 are in series as are those of T_3 and T_4, as indicated by the arrowheads.

Secondary S_2S_5 supplies current from S_2 through the cathode heaters to cathode and anode of tube T_3, relay coil CR to S_5. Capacitor C_1 connected across coil CR serves as filter to smooth out current flow through the coil and prevent the contacts chattering when they are closed.

On reverse polarity of secondary S_2S_5, a circuit for tube T_1 is from S_5 through resistor R_7, cathode to anode, resistors R_6 and R_1 rectifying tube T_4 to S_2. Resistor R_7 is shunted by capacitor C_6, so the ac voltage being amplified bypasses the resistor. This tends to prevent distortion of the amplified signal voltage applied to the grid of T_2. Capacitor C_5 is charged to the polarity shown and filters the half-wave output of rectifying tube T_4 to supply dc to tubes T_1 and T_2. Circuit for tube T_2 is practically the same as for T_1 except resistors R_4 and R_5 are in circuit.

Secondary S_1S_2 energizes the bridge circuits. From S_1, one circuit is to N_1 through resistors R_{12}, R_{13}, R_{14}, outdoor-temperature compensator R_{15}, resistor R_{16}, cycler resistor H_2 to N_2 and S_2. Another circuit is from N_1 through thermostats R_{10} and R_{11} and resistors R_{15}, R_{16} and R_{17} to N_2 and S_2. Also the grid of tube T_1 connects to R between R_{10} and R_9 and its cathode connects through R_7 to RG. These circuits are the same as in Fig. 3, and what we said about this figure applies to Fig. 2. Balancing the bridge turns on the heat and unbalancing it puts a minus bias on the grid of T_1 to turn off the heat.

Cycler Operation. Let's study the combined action of the cycler and thermostats to control the heating system. Assume the bridge voltages balanced, as in Fig. 1*A*, and the relay has closed contact CR_1 to turn on the heat and CR_2 to energize cycler heater H_1. For the polarity shown in Fig. 2, cycler heater circuit is from S_2 through H_1 back to S_5. Two things are now happening in the bridge circuit: (1) Cycler element H_1 heats element H_2. (2) Resistance of

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Users of GARLOCK Mechanical Seals have reported outstanding service records on a wide variety of applications. Here are just two taken from the many in our files:

- Over 3 years' service and still in operation, on a 1¾" shaft of a boiler feed pump handling water at 220°F. and 200 p.s.i., and operating at 3600 r.p.m.
- Two years' service, and still in operation, on a 1" shaft of a pump handling paint at 130°F., 10' Hd., operating at 1750 r.p.m.

GARLOCK manufactures mechanical seals in many standard and special designs from a wide range of high quality materials. For more information, write for our Mechanical Seal booklet or call your GARLOCK representative.

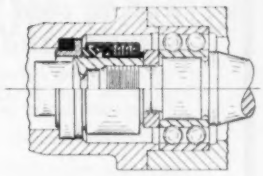
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

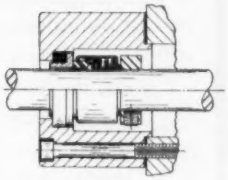
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

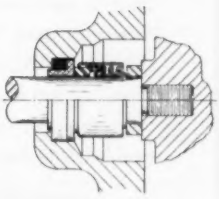
GARLOCK

TYPICAL APPLICATIONS of GARLOCK Mechanical Seals for Rotary Shafts

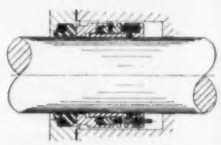
PACKAGE SEALS





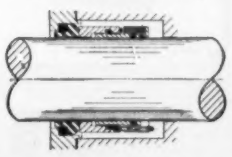


CHEVRON-TYPE SEALS



Type CB—Balanced "Chevron" Seal

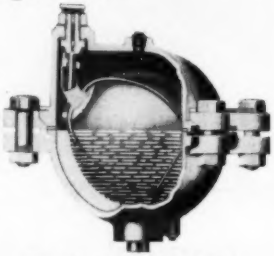
"O" RING SEALS



Type OB—Balanced "O" Ring Seal

How to get rid of ACCUMULATED AIR IN PIPE LINES . . . *carrying hot or cold water, industrial liquors, sewage and other liquids . . .*

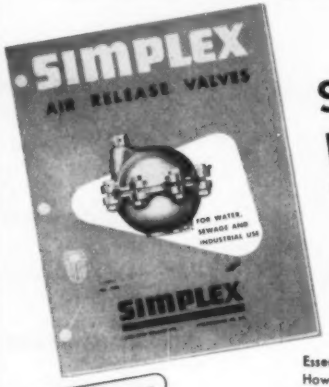
The accumulation of air in water lines under pressure presents the engineer with many problems. Air, lodging at peaks in the line, reduces the effective area of the pipe, creates a friction head, lowers the entire line's pumping capacity, and may result in serious water hammer.



Simplex Air Release Valve

The Simplex Air Valve is easily installed . . . positive in action . . . ample in capacity. Standard valves for pressures up to 250 p.s.i. . . . special valves for pressures up to 800 p.s.i. Thousands have been in successful use for over 30 years.

Simplex Air Release Valves bring a sure, efficient cure for these difficulties. Easy to install, simple in design, positive in operation . . . they vent accumulated air automatically before it can cause damage. To learn how *you* can avoid accumulated-air troubles, send without obligation for our new bulletin.



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PARTIAL CONTENTS

Essential Requirements for Air Release Valves
How Simplex Takes Care of Air in Pipes
Methods of Installation
Design and Construction Details

Write to Simplex Valve & Meter Co., Dept. 9, 6730 Upland St., Phil. 42, Pa.

IT'S ACCURATE IT'S SIMPLEX

SIMPLEX
VALVE AND METER COMPANY

ELECTRONICS

Continued from page 200

thermostats R_{1B} and R_{1A} increases because of a slight rise in room temperature.

As H_3 temperature increases, so does its resistance to unbalance the bridge and increase the voltage from R to N_3 as shown by curve AB_1C, Fig. 1*E*. As room temperature increases so does the resistance of thermostats R_{1B} and R_{1A} and volts across them. This reduces the voltage from RG to N_2, curve ABC, Fig. 1*E*. These changes in resistance and voltage act to unbalance the bridge in the same direction to increase the bias on tube T_1 to turn off the heat. This bias is represented by dotted curve AB_2C. When bias on T_1 increases to where voltage across relay coil drops below 25 v, contacts CR_1 and CR_2 open.

Opening contact CR_1 shuts off the heat, and CR_2 disconnects cycler element H_1, and it and H_2 start to cool. As H_2 cools its resistance decreases, as does voltage from R to N_2 to decrease the bias on the grid of T_1. Room temperature also drops slightly to cool the thermostats and increase the voltage from RG to N_2 and decrease the bias on T_1. When the bridge voltages are again in balance as in Fig. 1*A*, relay CR again closes to turn on the heat and energize the cycler.

About 85% of the change in bridge balance to turn on and off the heat is caused by the cycler, and 15% by the thermostats. As a result, heat is turned on and off by small changes in room temperature. As long as heating demand remains constant, heat is turned on and off at uniform intervals to hold room temperature constant to within 0.25 of a degree F of that set on thermostat.

Outside Temperature Falls. Assume that heating load increases because outside temperature decreases. Resistance of outdoor temperature compensator R_3 decreases as does the voltage across it. This causes several things to happen. Since the voltage across R_3 decreases it must increase across cycler element H_2 to turn off the heat. To do this the cycler's temperature must increase. Being at a higher temperature it will lose heat faster to the surrounding air and will take longer to heat, causing the heating period to increase.

Room temperature is increased so that thermostats' resistance and voltage across them increases. As a result, volts from R to N_2 and RG to N_3 is slightly lower when the heat is turned off than before outside temperature changed. This is shown by the voltage curves Fig. 1*F*. Because cycler element H_2 is at a higher temperature, when relay CR opens, it will cool faster to reduce its off period and turn on the heat. In this way the on heating period is increased,

Research and Control-Testing

assure uniformly high quality of

HARBISON-WALKER
REFRACTORIES

Top—Precision equipment used in the Harbison-Walker Research Laboratories for accurate control studies.

The lower picture shows several of the many laboratory furnaces in which the refractories are tested.

The uniformly excellent service rendered by Harbison-Walker Refractories in a large measure is attributable to the planned program of scientific research development and careful control of processing during manufacture.

In the Harbison-Walker Research Laboratories, studies are constantly made of raw materials, finished products, and refractories which have been in service. These studies lead to improvements that result in longer life and better service from the refractories.

Uniformly high quality of Harbison-Walker Refractories is assured by the rigidly-maintained system of control testing. All products are checked at every step of manufacture to make certain that they measure up to the highest standards in every respect.

When you use Harbison-Walker Refractories, you are using the *best!*

HARBISON-WALKER LEADING PRODUCTS FOR POWER PLANTS

HIGH-ALUMINA BRANDS
Alumina Classes Indicated
H-W Corundum 99% • Korundal 90% • Alcor 60% • Anchor 60% • Dialite 50%

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Harbison-Walker Fireclay Refractories are available also in various **INTERMEDIATE DUTY and LOW DUTY Brands**

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WORLD'S LARGEST PRODUCER OF REFRACTORIES
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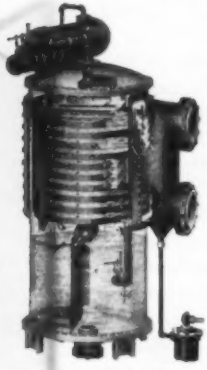
Prevent Corrosion!

Heat and Deaerate Feed-Water with Stickle Open Coil Heaters

Stickle Open Coil Heaters prevent corrosion by deaerating feed-water — removing destructive oxygen and CO_2. Staggered bars in circular, cast iron, 3-sectional trays force water to flow irregularly in a thin film, depositing solids and releasing non-condensable gases. Trays cannot overflow — may be easily removed for cleaning.



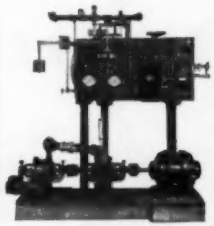
"X-RAY" View of Stickle Open Coil Deaerating Feed-Water Heater with cast iron shell

When you preheat feed-water with a Stickle Heater, the steam provides one-sixth of your boiler feed supply. Every bit of this "bonus sixth" is *pure* water, free from scale-forming substances. Open coils bring feed-water into direct contact with steam—immediately transmit heat from steam to water—cutting your fuel costs 10-15%!

Stickle Heaters are available in a wide variety of sizes—in capacities ranging from 3,000 to 250,000 lbs. MINIMUM RESULTS GUARANTEED FOR EVERY INSTALLATION. Write for detailed Bulletin 117. It's *free!*

STICKLE STEAM SPECIALTIES COMPANY
2265 Valley Avenue • Indianapolis 18, Indiana

other cost-cutting STICKLE equipment



Stickle Differential Drainage and Boiler Return System

Stickle Regulating and Reducing Valves

Stickle Open Float Steam Traps

FREE!—Write for free illustrated Stickle bulletins describing equipment shown above. Ask for Bulletins 250 (Return Systems), 235 (Valves) and 115 (Traps).

ELECTRONICS

Continued from page 202

and the off decreased to meet the increased heating demand.

The outdoor-temperature compensator R_o in effect automatically raises the temperature control point of the cycler to compensate for lower outside temperatures. The compensator detects changes in outside temperature when they occur and corrects room temperature accordingly. It does this long before an outdoor temperature change can be detected on the inside, and prevents uncomfortable periods that may occur when heating control is by inside temperature only.

Morning Heat. When heating a building in the morning after heat has been reduced at night, the cycler also serves to prevent overheating. With thermostat control only, heating is started as soon as the control is turned to the desired day temperature. The furnace then runs until room temperature comes to that set on the thermostat and shuts off. But, excess heat stored in the furnace and system causes overheating. With the electronic system, heating continues until room temperature returns the bridge balance to where the cycler takes control, about 2 deg below the control point. Here cycling begins, and the control point is approached at a decreasing rate without overshooting.

DISSOLVED OXYGEN

Continued from page 79

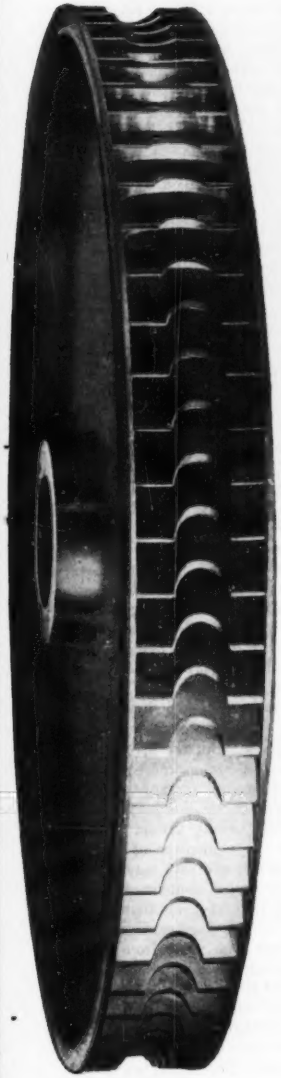
utes by the Winkler method. Within 16 minutes zero oxygen readings are obtained in the deaerated water. But we run the system for an hour before starting any work on our proposed test method.

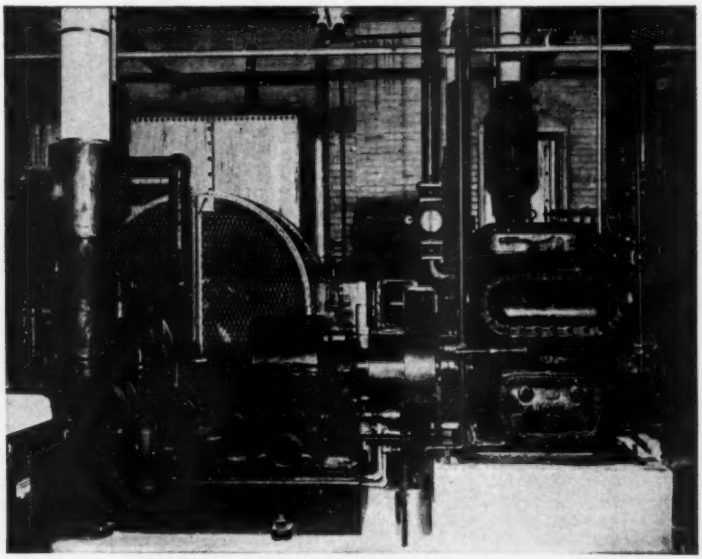
Seventeen tests already recorded on deaerated water, under stabilized conditions, with the above setup and *Procedures*, gave a mean oxygen content of 0.0007 ml per l with a mean deaeration of 0.001 ml per l. Table, bottom of p 78, gives a representative set of readings on four samples drawn at one time.

Test Comparisons. Next we took tests on deaerated water to which we added measured amounts of air-saturated water of known oxygen content—0.0274 ml per l. Amounts found were 0.0285, 0.0285, 0.0287, 0.0288. With an added oxygen content of 0.0548 ml per l we got 0.0562, 0.0562, 0.0570, 0.0562. In no sample did results from two operators differ by more than 0.001 ml per l on water of about 0.05 ml per l of oxygen.

Sampling Errors. A simple method of sampling, using a narrow-mouthed stoppered bottle with supply tube carried to the bottom, has proved quite

the Terry Turbine





Refrigeration Compressor Driven By Terry Turbine

AT HAMPDEN BREWERY

This 150 hp Terry Turbine — at the Willimansett, Mass. plant of the Hampden Brewing Co. — operates at 3800 rpm with a gear reducing it to 720 rpm. It is coupled to a 6 cylinder reciprocating compressor.

The installation is running on steam conditions of 120 psi — 0° superheat, and the steam to the turbine is automatically throttled to maintain a constant 30 psi back pressure for process and heating. The installation was developed by Fred Ophuls & Associates Consulting Engineers.

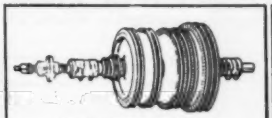
Get more information on the wide range line of Terry Turbines from your local District Representative. There's no obligation for a complete discussion of your specific requirements. Also send for Bulletin S-143 that gives full details.

THE TERRY STEAM TURBINE CO.

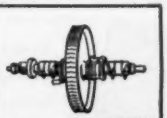
TERRY SQUARE, HARTFORD 1, CONN.

TT-1196

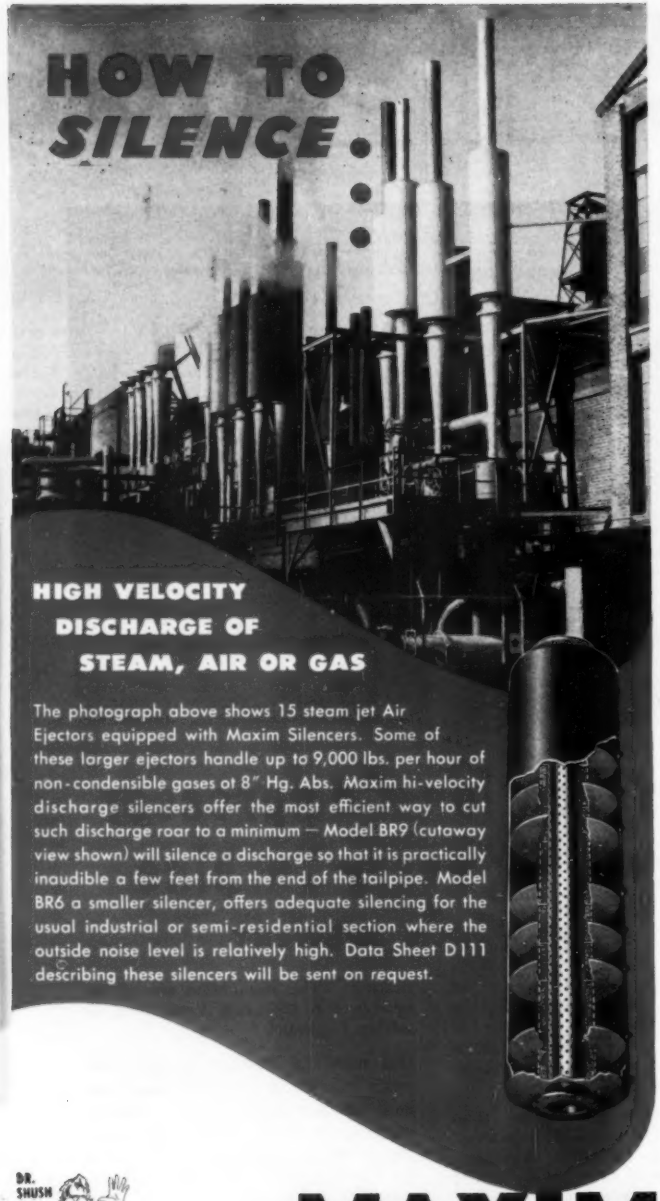
Terry



MULTI-STAGE TURBINE



SOLID WHEEL TURBINE


HOW TO
SILENCE
HIGH VELOCITY
DISCHARGE OF
STEAM, AIR OR GAS
The photograph above shows 15 steam jet Air Ejectors equipped with Maxim Silencers. Some of these larger ejectors handle up to 9,000 lbs. per hour of non-condensible gases at 8" Hg. Abs. Maxim hi-velocity discharge silencers offer the most efficient way to cut such discharge roar to a minimum — Model BR9 (cutaway view shown) will silence a discharge so that it is practically inaudible a few feet from the end of the tailpipe. Model BR6 a smaller silencer, offers adequate silencing for the usual industrial or semi-residential section where the outside noise level is relatively high. Data Sheet D111 describing these silencers will be sent on request.
DR. SHUSH
Consult MAXIM
THE MAXIM SILENCER COMPANY 92 HOMESTEAD AVE., HARTFORD 1, CONNECTICUT
Gentlemen: Please send for bulletin on High Velocity Discharge Silencer
NAME
COMPANY
ADDRESS

DISSOLVED OXYGEN

Continued from page 204

satisfactory. It takes about 20 seconds, average, to remove the stopper and make the first two additions of solvent. The increase in oxygen, based on samples unstoppered for 15 minutes, indicates oxygen absorption for 20 seconds as somewhere below 0.001 ml per l. If desired, the first two additions can be made under water and the sample bottle stoppered, as Daugherty[3] suggested.

In routine testing very little reacting time, maybe a minute, is given after the addition of the first two reagents. When tests were made on a water of 0.029 ml per l no difference was found when reaction time was extended to 30 minutes.

Errors may arise from impurities in or additions to the water. Organic matter, like nitrites, free chlorine or hypochlorites, sulfates, can interfere with the estimate's accuracy. These errors may be positive or negative. To check these errors we used the Schwartz and Gurney method to determine differences in estimated oxygen between two samples of 1000 and 500 ml. By thus canceling out interference from impurities, results come within 0.001 ml per l of the directly estimated figures—well within the error of the method as finally computed, and hence not significant.

Reagent Oxygen. Oxygen in the reagents, considered by some as an important source of error, (although not by the authors) showed, with tests using ten times the normal quantities of reagents, an increase in oxygen content equivalent to 0.002 ml per l. For normal quantities this error is no more than 0.0002 ml per l.

Incomplete extraction of iodine from the water can cause an error that will always be negative. But the error will be significant only when there is an appreciable amount of oxygen in the original sample. In the method outlined unextracted iodine should never be more than the equivalent of 0.001 ml of oxygen per l, and very much less than this where oxygen content of sample approaches zero, say, less than 0.01 ml per l.

Possible errors can occur from (1) inaccurate burette reading (2) minimum amount of iodine solution needed to show a blue color with starch (3) general error in judging endpoint. There are precautions you can take to keep these errors within limits. By using a burette graduated to 0.01 ml and estimating to 0.005 ml, for example, burette reading errors are reduced. Next you can allow for the amount of iodine needed to show a blue color by subtracting a definite blank, or by balancing the thiosulfate and iodine solutions, as we did, under conditions

less servicing...more service

Steam power plants, using Monsanto Santosite to eliminate oxygen corrosion, are *spending less* time and money on servicing and *getting more* service out of their boilers.

Santosite (sodium sulfite anhydrous, technical) is safe, economical, easy to use. It takes *all* dissolved oxygen out of boiler feed water by combining with the oxygen to form harmless sodium sulfate. Neither Santosite nor sodium sulfate forms sludge or otherwise damages boilers or pipes.

We suggest you get complete information on the use of Santosite to eliminate oxygen corrosion by writing for the Monsanto Technical Bulletin No. O-26, "*Santosite for Removing Oxygen from Boiler Feed Water.*" MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 S. Second Street, St. Louis 4, Missouri.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

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MONSANTO
CHEMICALS AND PLASTICS

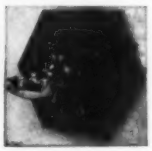
SERVING INDUSTRY...WHICH SERVES MANKIND

REGISTER TYPE COMBUSTION UNITS...

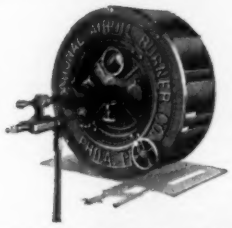
FOR YOUR "CONICAL FLAME" REQUIREMENTS

UNIVERSAL (REGISTER TYPE) COMBUSTION UNIT

Can be furnished with Gas Burners or steam or mechanical atomizing Oil Burners, for either natural or forced draft. Air vanes are variable independently of each other and adjustable or instantly reversible from left to right hand turbulence or vice versa as a unit. Has a dual feature for controlling air volume, independent of turbulence. Capacities up to 500 gals. of oil (60,000 lbs. steam) per hour.



MECHANICAL-PRESSURE ATOMIZING OIL BURNERS



Mechanical-pressure atomizing (marine type) oil burners for firing high pressure steam boilers. Capacities 10 to 500 gals. per hour. Require oil pressures of 75 to 300 lbs. per sq. in. and oil temperatures up to 300° F., depending on grade of fuel oil and furnace design. Standard or wide range types. Air Registers available for natural or forced draft.

LOW AIR PRESSURE OIL BURNERS

Type LAP Burner and Register, shown mounted on furnace wall with Indicating Air and Oil Control Valves. The Type LAP Oil Burner is for use with low pressure air furnaces, crucibles and other metal melting for firing forging, reheating, heat treating furnaces, core ovens, galvanizing kettles, dryers, bake ovens, cookers, air heaters, kilns, glass tanks, glory holes, enameling furnaces, asphalt kettles and other process furnaces. (Patented July, 1943.)

Where it is preferable to use the cone flame for firing steam boilers and other industrial furnaces, NATIONAL AIROIL BURNER CO. offers these Register Type Combustion Units in several types, and models for either natural or forced draft.

NATIONAL AIROIL BURNER CO. stands ready to serve your every need or special problem when it comes to Oil Burners—Gas Burners and allied equipment. We feel that you'll be interested in the full particulars we give regarding your oil-gas-combustion requirements . . . *write us today, won't you?*

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes; STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

NATIONAL AIROIL BURNER CO., INC.

Main office & Factory: 1250 EAST SEDGLEY AVENUE
PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD
HOUSTON 6, TEXAS

DISSOLVED OXYGEN

Continued from page 206

similar to those of actual titration like acidity, temperature. Personal error in judging endpoint should be no more than 0.001 ml per l under normal conditions.

Total Errors. From this survey of probable errors three major sources appear—manipulative ± 0.001 ml per l, maximum; titration ± 0.001 ml per l, maximum; incomplete extraction —0.001 ml per l, maximum—for a total maximum probable error of ±0.002 ml per l for the whole process. This test takes much more time than the simple Winkler because of the manipulations in the separations. Beginning with 1000 ml and finishing with under 50 ml concentration of iodine is about 20 times. If you want a greater degree of delicacy you can start with more than a 1000-ml sample. For less accuracy take a smaller sample, 500 ml, which gives a 10-time concentration. The main point is that final titration, involving a small sample free of contaminants present in the original sample, gives very precise results.

MARMADUKE

Continued from page 142

the older Indians and having a hut full of rowdy half-breeds, Travis took to hitting the firewater.

"One night he took a jug to the coal mine powerhouse where he fired. He nursed that jug along on the sly. After a while he got groggy and lay down on the coal pile outside the boiler room to sleep it off. And that 's when it happened.

"The feed pump stopped and No. 1 boiler let go. The old locomotive-type boilers' crown sheet buckled from low water. Then it blew out, along with the rear header. The explosion took out one side of the building wall. But it was a freak accident, and no one was hurt.

"Travis was fired on the spot. But a few months later George Gleason was short on help and took him on at his plant.

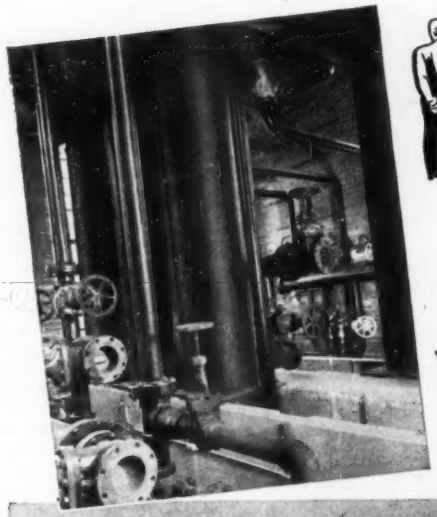
"That accident confirmed the older Indians' belief that this paleface was no good. They had been saying it for ten long years, and now they had proof. That's why they named Travis 'Pineh be e shek na-ajil-tsel to-dil-hil aji-dlank go' at their next council meeting. Travis was plenty unhappy about it and took to brooding more than ever.

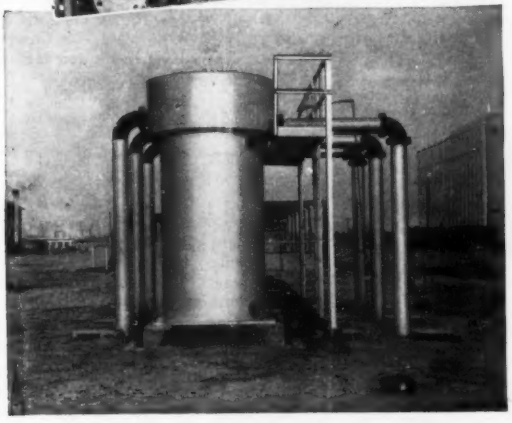
"A few weeks after I started on that job, Travis showed up feeling pretty good one morning. 'What's it all about?' I asked.

" 'Last night the old chief held a

Dirty Water can't "Shut-down"...

Vogt





film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441

River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

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MALLEABLE IRON
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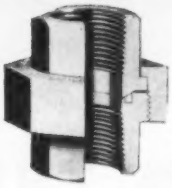
... featuring the RECESSED BRASS SEAT



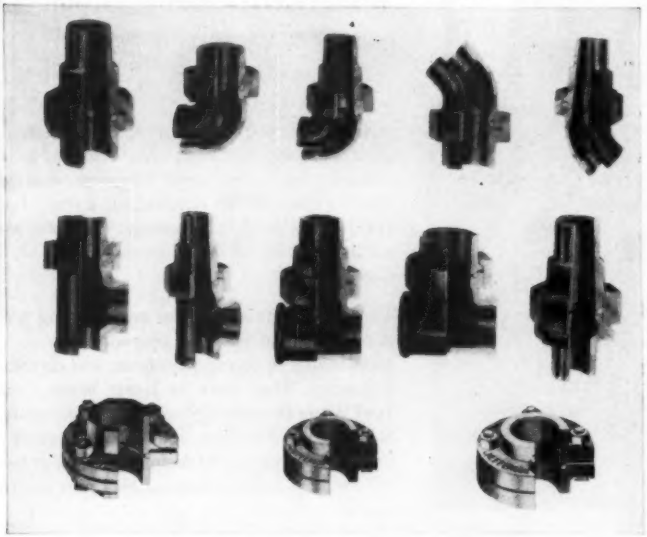
... for fewer and better pipe joints

The Recessed Brass Seat—an exclusive feature of *all* Jefferson Unions—is provided by inserting a *machined seamless brass ring* (not a casting) into a *machined* recess located in the run way of the fitting. Location, materials and method of insertion provide a time-proved leak-proof construction.

This feature definitely assures better pipe joints. The fact that Jefferson makes a complete line of 45° and 90° Union Ells and Tees means fewer pipe joints and simplified piping jobs.

In addition, Jefferson can furnish 300# AAR, Enduro 300#, Excel 250#, Master 150# as well as All-Iron Seat Unions.

Your nearest distributor can supply your needs—or contact us direct.



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39 Fletcher Ave., Lexington 73, Mass.

MARMADUKE

Continued from page 208

council meeting,' he explained. 'I rode over and asked him to change my name.' 'Look here,' I told the chief in Navaho. 'I married one of your squaws years ago. All my children are half Indian. And they're growing up with that tag you handed me. I don't care about myself, but why not give the new generation a break?'

"'The chief shook his head slowly and said that a reputation wasn't easy to change.' 'Reputation go to happy hunting ground,' he growled.

"'But I kept asking him to think it over, and finally he said he'd take it up at the council meeting. So tonight I'll ride over that way and learn what they decided.'

"Next day Travis came in looking lower than a belly plug on a Scotch boiler. About six of us were drinking coffee in the locker room when he threw down his lunch pail. We could tell the big powwow didn't come off right to suit him. 'What tag did the old chief hand you this time?' we asked, knowing something was rotten.

"Travis plopped down on one end of a bench and looked around hopelessly. Then he rattled off in Navaho, 'Aldoj be e shek do-no-ajil-tsel dah to dilnil na-ajil-tsel go.'

"'And what in hell does that fancy handle mean?' I asked. Travis stuffed his jaw with a quid of Climax chewing tobacco and answered out of one corner of his mouth, 'He does *not* break his kettle when he drinks firewater.'

"Well, he had a new tag, but somehow he wasn't happy."

LAKE COOLING

Continued from page 89

Altitude Effects. The final formula is developed for 25-in. Hg barometer (5000 ft), as are Fig. 5, 6 and 7. Results are only slightly affected by altitude. For other elevations, the constants 78.0 and 0.0084 in the final formula should be replaced as follows:

Altitude, ft	*First constant*	*Second constant*
0	70.6	0.0100
1000	72.5	0.0095
5000	78.0	0.0084
8000	82.4	0.0073

Acknowledgments. Personnel of the results department of the Valmont Plant gathered basic field data without which this study could not have been made. We are indebted to them for their effort. The betterment department of the company rendered valuable assistance in reviewing the literature and making the many calculations that ultimately crystallized in the formula presented.

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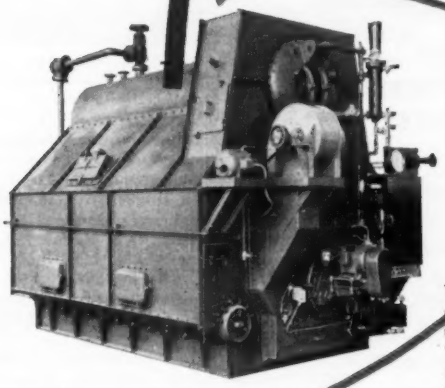
YOU NEED



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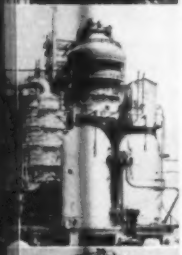

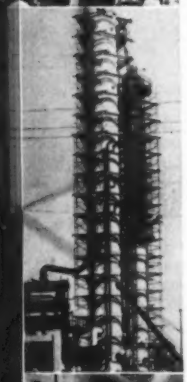

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BURNING BARK

Continued from page 95

bility and high ash. We chose spreader stokers because they cost less. Traveling grates were specified to give better control of fuel bed. A single-roll crusher controls maximum size of coal. Grates are somewhat unusual in that they travel toward rear of furnace. This was done on the chance that some wood waste chuted in near the front wall might not flash but fall to the grate and be discharged to the ashpit without burning completely.

As a second line to fall back on if the cheap chutes didn't work as expected, trials were run on bark, using a standard Riley Stoker Corp spreader, in their Worcester plant. These tests proved that a good distribution pattern of bark over the grate could be had. That company became interested and ultimately their Canadian licensees, Foster-Wheeler Ltd, built the boilers, grates, stokers and bark chutes.

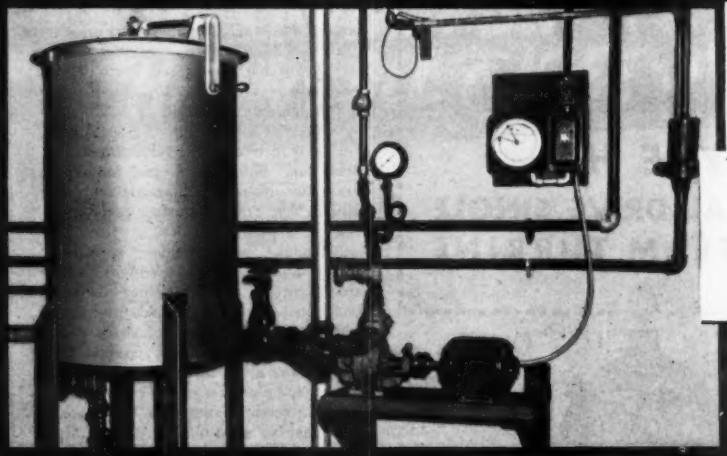
Burning Coal. When wood room is in operation, bark will have to be supplemented with coal. Coal costs $9.62 per ton, delivered (41c per million Btu). We felt this justified good combustion control for coal firing. As overfire air nozzles would be needed with a spreader we could pipe some of this air to bark chutes if later operation showed need for air to cool chutes or move materials without adding to excess air. Experience and observation to date show that air isn't needed in the chutes.

Vertical gas velocity up through the furnace was purposely held down to provide time for consuming the bark before it reaches cross tubes. At peak capacity (250,000 lb per hr) velocity is 17.5 fps when burning coal. Heat release at 250,000 lb per hr is 21,200 Btu per cu ft per hr for coal and 21,800 for coal and wood. At 180,000 lb per hr, these releases drop to 14,940 and 15,800 respectively.

The 15,160-cu-ft furnaces are water-cooled on all four sides. Rear wall tubes bend back and refractory covering at lower end radiates heat to discharge end of stoker grate.

Stokers. There are eight 20-in.-wide over-running reel-type coal feeders in each boiler, set about 4 ft above grates. Coal chutes directly to each stoker hopper from an overhead bunker above the firing aisle. Feed rate of stoker is adjustable from the board, by hand or by automatic control.

Grates are under manual speed control. There are two independent 15-ft-wide traveling grates side-by-side in each furnace. Total effective grate surface is 540 sq ft. Under the grates there are four air zones making it possible to have a short fire near the front of the



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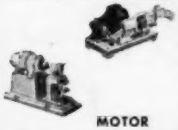
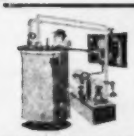
BY-PASS FEEDERS

MECHANICAL CHEMICAL PUMPS



MOTOR OPERATED CHEMICAL PUMPS



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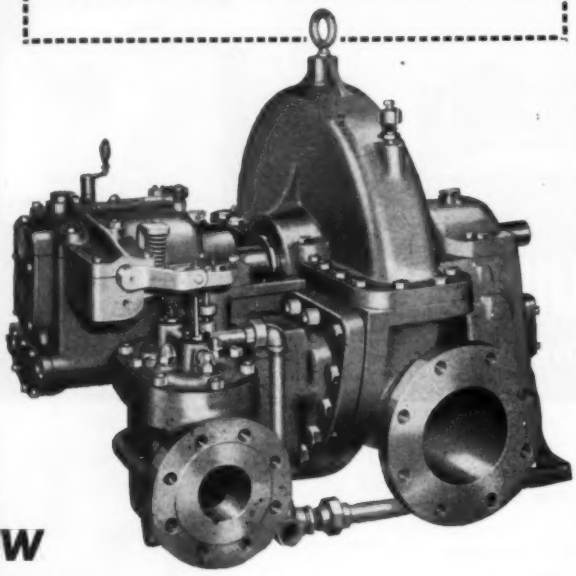

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BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

BURNING BARK

Continued from page 212

furnace across full boiler width. Forced-draft air from tubular air heater is kept below 300 F to prevent grate overheating.

To eliminate corrosion at cold end of preheater tubes when load is light, hot air is recirculated to inlet of forced-draft fan. Both forced- and induced-draft fans are under automatic control. Boilers have extended-surface economizers.

Although we consider spreader stokers tops among the solid-fuel burners in respect to birdnesting, conventional soot blowers have been provided with retractable units at furnace exit (entrance to superheater). Special attention was given to arrangement and wide spacing of first row of cross tubes because of poor experience, elsewhere, with slagging when burning certain oils and, also because of reported slagging when burning hogged fuel which has been soaked in salt water. The ash fusing temperature of Telkwa coal is only 2000 F so we didn't want to gamble on unknown fluxing action of coal ash in presence of wood ash containing sea salt.

Early operation indicates good performance when burning bark with coal. Bark is light, shredded and runs less than 50% moisture. It seems to ignite as soon as it enters the furnace, even at light loads when coal flame is relatively short and below it. Apparently, very little falls to the grate.

Due to the rather high furnace, it is necessary to balance the draft near the grates when burning coal only, to reduce excess air leakage. When bark is burned, it is better to set furnace draft as needed at bark-chute level. There has been some evidence of "puffing" when burning bark. This is caused by the four bark chutes receiving "slugs" from the conveyor at the same time. Respacing the flights of the conveyor so they don't register with all four chutes at once cured this trouble.

More POWER NEWS

Continued from page 148

pated we have an excellent chance of producing crude shale oil at a cost competitive with natural petroleum," Guthrie said. "The grade of crude obtained will be somewhat inferior to the average petroleum, but finished products of good quality can and will be refined from it," he added.

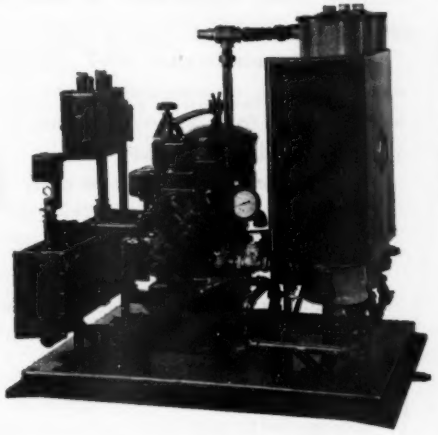
Major objectives of the new retorting plant, as listed by Guthrie, are to (1) determine cost and yield data that will permit an accurate evaluation of the "gas-combustion" process (2) provide the technical information that industry needs to design commercial plants and (3) supply crude shale oil in the quantities required

A DE LAVAL "PURI-FILTER" THROWS ALL THREE OUT

Dirt, water and carbon are all promptly removed from diesel lubricating oil by the De Laval "Puri-Filter." Dirt is thrown out and stored in the bowl of the centrifuge. Water is separated from the oil and continually discharged to waste. Then the purified oil is passed through filters which remove all remaining impurities including colloidal carbon.

The "Puri-Filter" is the surest way there is to make certain that diesel lubricating oil is properly clean — it leaves absolutely nothing in the oil that can contaminate it or clog the lubrication system of an engine. Ring sticking is minimized; bearing life is increased.

The De Laval "Puri-Filter" yields other advantages. For example, it does not remove valuable additives from the oil. Moreover, it speeds up engine inspection and takes the curse off one of the dirtiest jobs in the power plant—crank case inspection.



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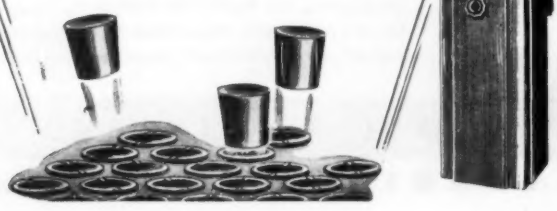


CD-31

More POWER NEWS

Continued from page 214

for the Bureau's refining studies. Plant design will permit a wide range of experimental operating conditions, he said, and will include all necessary instrumentation for accurate process control and exact measurement of results.

The new "gas combustion" process has two novel and important features: (1) The process gets its name from the fact that it produces and uses as a source of heat for retorting a low Btu gas obtained from the shale and burned in the presence of air. (2) It requires neither water nor an elaborate system for condensing liquid products coming from the retort.

COMING EVENTS

Sept 10-14—Sixth National Instrument Conference and Exhibit, Instrument Society of America, Sam Houston Coliseum, Houston, Texas. ISA, 921 Ridge Ave, Pittsburgh 12, Pa.

Sept 25-28—American Society of Mechanical Engineers, fall meeting, Radisson Hotel, Minneapolis, Minn. O B Schier, chairman, ASME, 29 W 39th St, New York 18, N. Y.

Oct 11-12—American Society of Mechanical Engineers, fuels div, Hotel Roanoke, Roanoke, Va. O. B. Schier, chairman, ASME, 29 W 39th St, New York 18, N. Y.

Nov 5-8—All-Industry Refrigeration and Air-Conditioning Exposition, Navy Pier, Chicago, Ill. George E Mills, show director, 1346 Connecticut Ave, NW, Washington 6, D. C.

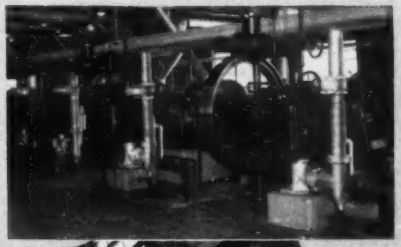
Nov 26-Dec 1—23rd Exposition of Chemical Industries, Grand Central Palace, New York, N. Y. C F Roth, mgr, International Exposition Co, Grand Central Palace, New York 17, N. Y.

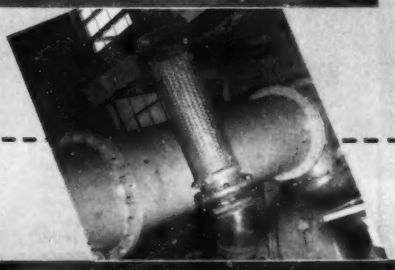
British Exhibit Their Gas Turbines

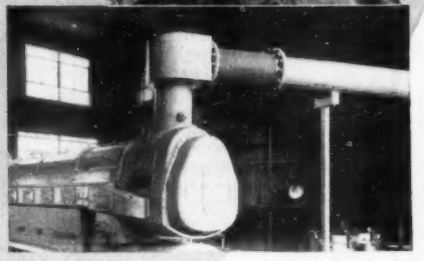
By special report to POWER, Dr P F Martinuzzi, Cornell University, tells of Gas Turbine Week at the Festival of Britain in London, England. Exhibits included aviation jet and turboprop engines, Rover gas-turbine car, Metrovick locomotive model, motor-torpedo boat carrying first sea-going gas turbine, harbor launch with Rover gas turbine.

Gas turbines are finding increasing acceptance in Britain as shown by units under construction and under test for stationary and marine fields. Seven marine units ranging from 150 to 6000 hp are being built or tested. Industrial sets total 25 with capacities varying from 750 to 20,000 kw. The Ruston Hornsby 750-kw unit has successfully completed its tests with a running period of 1000 hr. Orders for this model have been received. Six units of 10,000 kw capacity and larger are

Large Diameter CMH REX-WELD CORRUGATED FLEXIBLE METAL HOSE







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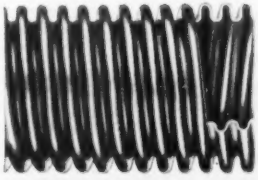
For full information and data sheets see your local CMH distributor—look for his name in your classified telephone directory—or write direct.



CMH REX-WELD Type RW-75 is helically corrugated flexible steel hose and is made in sizes from 5" to 24" I.D., inclusive. Furnished with standard pipe nipples, couplings, fixed or floating flanges. Flanges to customers design can also be attached. Where required RW-75 can be supplied with metal braid covering.

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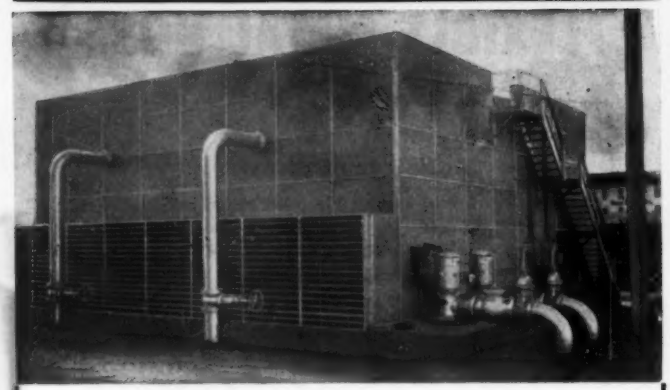
UNITED
COOLING TOWERS



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Properly sized to take care of all peak load requirements. Carefully engineered to meet individual cooling problems. Constructed of any specified and mutually acceptable quality materials.

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More POWER NEWS

Continued from page 216

nearing completion for power generation. Two of these are 20,000-kw units designed by English Electric.

By next year about twelve new units built by six firms will be running. Experimental work is under way to use cheap fuels such as peat, coal and methane from coal-mine gases.

The British are developing the regenerative heat exchanger successfully for pressure ratios up to 4:1 using an ingenious seal developed by Dr Rigby of Shell Oil Co.

President Aleman of Mexico, accompanied by several of his ministers and other government dignitaries, attended the opening of the new vertical turbine pump plant at **Worthington Pump and Machinery Corp** in Mexico City.

WITH OUR READERS

Continued from page 5

How Closed Is Closed?

It is only recently I have had the opportunity to read your issue of November 1950. The article by E J Kates—"20 Pointers on Cooling System Layout"—says:

> "Closed systems recirculate jacket water through closed heat exchangers. Thus the same water remains in the system indefinitely and is recooled without exposure to air. If it is pure at start it stays pure."

This opinion cannot be accepted and actually is incorrect, because after a period of time and for several reasons, tube failures can occur. This will result in the raw water (for cooling) mixing with the circulating water, with all the difficulties this entails. It is therefore necessary, in any heat exchanger, to have pressure of circulating water greater than pressure of raw water.

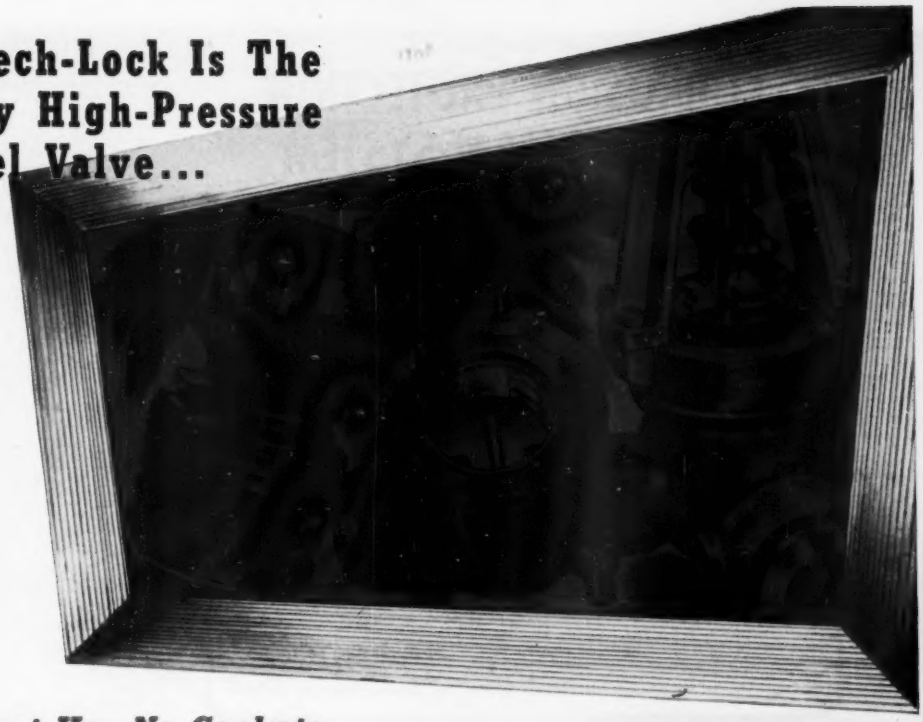
The problem of water contamination is well known by operating engineers and must be carefully examined and solved by designers.

Buenos Aires, Argentina J Jacquinet

Engineers probably shouldn't use words like "stays"—engineering being pretty much a matter of probabilities. Certainly there are possibilities for contamination of closed-system jacket water by leaks or other accidental means. Yet the probabilities of the water staying pure are high enough, we believe, to justify the positive—and concise—expression "stays pure."

Your point about higher pressure on the pure-water side is a good one, Mr. Jacquinet. In the case of a diesel plant, however, not much harm results if this precaution cannot be taken. Any leakage of raw water into the jacket system will show up as overflow from the surge tank. With this warning, operator can drain system, find and repair the leak and refill with fresh pure water.—*Ed.*

Breech-Lock Is The Only High-Pressure Steel Valve...



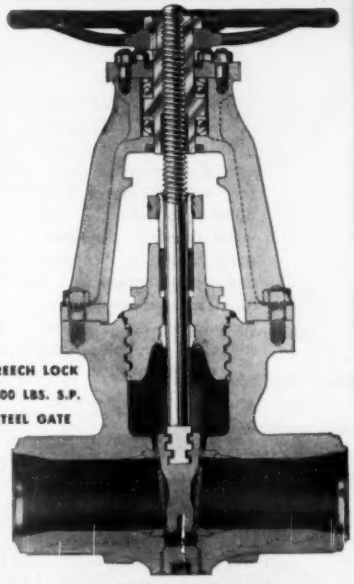
- ***That Has No Gaskets***
- ***No Bolts***
- ***No Threads***
- ***Yet Can Be Readily Disassembled In The Field***

Pressure-tight — without expensive maintenance. Designed to eliminate *all* the common causes of steel valve failure. That's Breech Lock — the exclusive, patented high-pressure valve with the positive *locking* action.

On the Breech Lock Bonnet are four rows of heavy, precisely machined lugs. Matching lugs are in the body. When the bonnet is turned 45°, the lugs intermesh— lock together to carry full internal pressures and distribute stress evenly. A seal weld, which can be readily chipped away with an air-hammer, is applied at the bonnet-joint.

There are no sealing surfaces to corrode, no flanges, gaskets, or bolts to require periodic maintenance. Result — *peak* valve efficiency under the severest conditions.

Write for your copy of "Lunkenheimer Cast Steels," a useful and interesting brochure on the selection of alloys for high-temperature, high-pressure valves. Address: The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.



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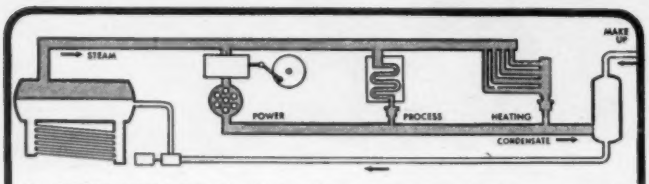
CORROSION PROTECTION for your STEAM SYSTEM

Think of

CORAVOL

(The Original* AMINE PROCESS)

Because CORAVOL Circulates to Control Corrosion



The CORAVOL ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of chemical treatment for: . . . boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** you will use is formulated to do the best protective job under your own plant conditions.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

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More FREE BULLETINS

Begins on page 163

pen speed specially designed to measure the rapid change variables encountered in many laboratory and test applications. 2-page data Sheet No. 10.0-7. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Wayne & Windrim Aves, Philadelphia 44, Pa.

B29 **DC DYNAMOMETERS** — Gives informative data on Type TLC (cradled), 250-volt dc dynamometers for direct connection testing of internal combustion engines, electric motors, pumps, blowers, and compressors. Features, applications and operation given. 4-page bulletin No. GEA-5552. General Electric Co, Apparatus News Bureau, Schenectady 5, N. Y.

METERS AND INSTRUMENTS, MECHANICAL

B30 **RECORDING THERMOMETERS** —Descriptive information and specifications covering recording thermometers, dial indicating thermometers, recording gages, transformer thermometers and freezer thermometers. 8-page bulletin. Electric Auto-Lite Co, Instrument & Gage Div, Toledo 1, Ohio.

B31 **TACHOMETER INDICATORS**—Discusses new multiple head, single range, fixed installation tachometer indicators for monitoring speeds of many remotely located machines from one convenient location. 4-page data sheet No. 42R. Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.

B32 **OXYGEN RECORDER**—Descriptive data on the Hays magnotherm oxygen recorder with sections devoted to analyzing, recording, gas sampling systems, and results. 16-page bulletin No. 51-829. Hays Corporation, Michigan City, Ind.

PIPING, FITTINGS, VALVES AND SPECIALTIES

B33 **STEAM COSTS**—Booklet, "How Increasing Your Steam Costs Can Save Money," answers 16 provocative questions such as: How little steam do you need?—Can your space heating system run wild?—Are bypasses necessary? 8-page booklet No. 2171. Sarco Co, Inc, Empire State Bldg, New York 1, N. Y.

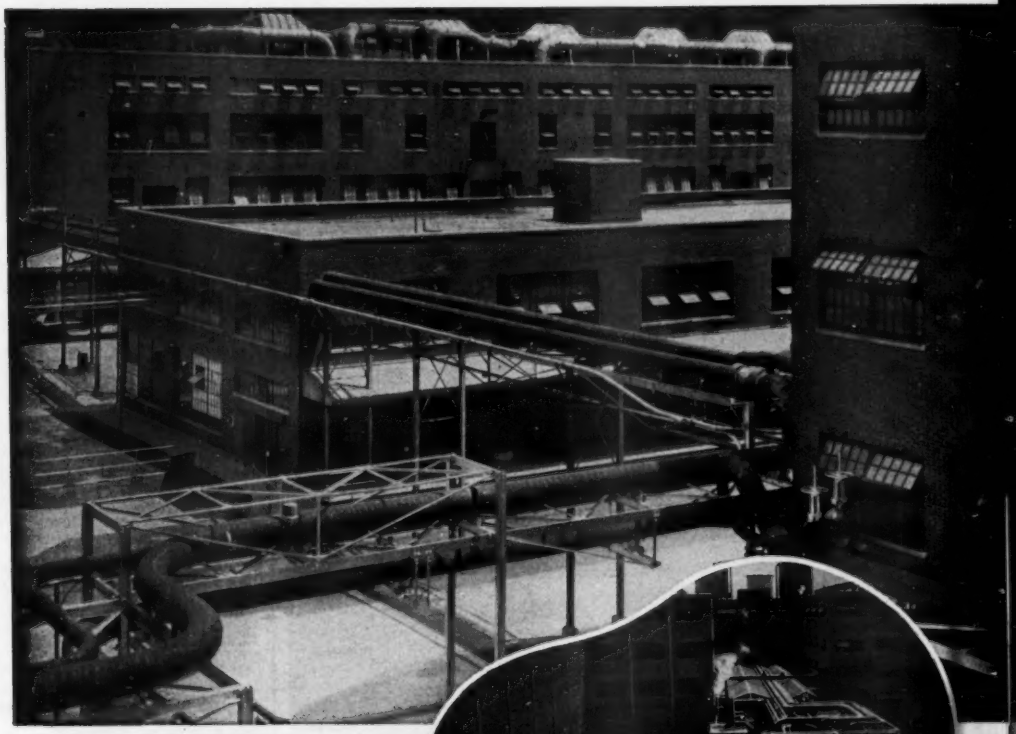
B34 **OIL VALVES** — Gives data on Micro Cam oil valves for controlling the flow of oil to industrial oil burners. Applications, valve capacities, and dimensions are included. 4-page catalog No. 704-A. Hauck Mfg Co, 124-136 Tenth St, Brooklyn 15, N. Y.

B35 **STEAM AND AIR TRAPS**—Gives prices and data on steam and air traps featuring the Armstrong inverted bucket principle. Section devoted to calculation of condensate loads and selection of traps to handle these loads. Capacity chart and parts list are included. 12-page catalog. Armstrong Machine Works, Three Rivers, Mich.

B36 **CREEP STRESS CARD** — Card gives creep stress data on a number of tubing steels for rates of 1% elongation in 10,000 and 100,000 hours at temperatures from 800 F to 1500 F. Data Card No. 102-F. Babcock & Wilcox Tube Co, Beaver Falls, Pa.

★ **PIPE HANGERS** — Presents a complete line of adjustable pipe hangers, vibration eliminators, and supports. Technical section includes information on specifications, hanger problems, weight of piping materials, thermal expansion pipe chart, Flex-Anal charts and typical piping problem solved by them. 96-page catalog No. 51. Blaw-Knox Co, 1525 Pennsylvania Ave, Pittsburgh 12, Pa. (*Write direct to manufacturer on company stationery giving name and title.)

B38 **ALLOY STEEL TUBING** — Condensed data on microstructure, critical points, effect of alloy elements, forging, machining, welding and thermal treatment for 14 grades of low carbon alloy steels used in production of



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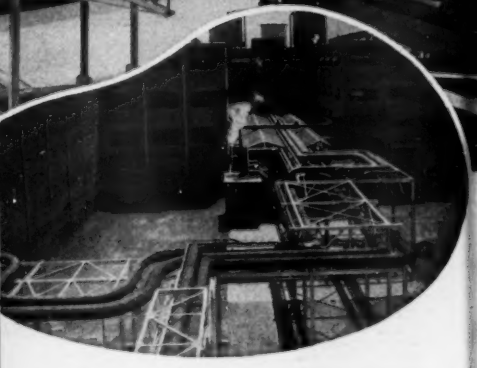

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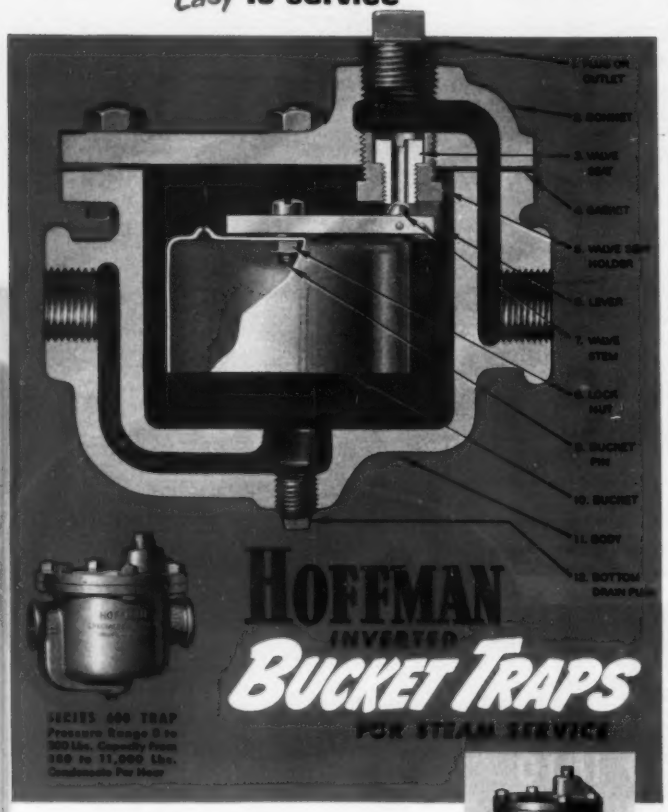
This simple mechanism is *Easy* to install... *Easy* to service



HOFFMAN Bucket Traps operate intermittently and are particularly applicable to draining condensate and air from steam lines or equipment where large quantities of air and condensate must be discharged. They are easily inspected, cleaned and serviced by merely removing the cover assembly.

Straight-through pipe connections permit close-to-floor installation.

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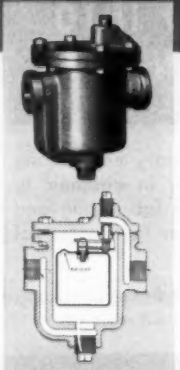

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tubular parts. 4-page bulletin No. TDC 149. Babcock & Wilcox Tube Co, Beaver Falls, Pa.

B39 **INSTRUMENT TUBING** — Describes advantages of plastic-coated metal tubing where high corrosion resistance is required. Photographs of installations and tubing service data for severe applications are included. 2-page bulletin "Dekoron Instrument Tubing." Samuel Moore & Co, Dekoron Tubing Div, Mantua, Ohio.

PUMPS

B40 **DIRECT FLOW PUMPS**—Gives full details on the Aldrich 6 in. stroke direct flow pump including design, performance and construction data, dimensional and sectional drawings, and pump specifications. 8-page data sheet No. 67-A. Aldrich Pump Co, Allentown, Pa.

B41 **ROTARY PUMP** — Illustrates and describes in detail an improved rotary type of pump, including sectional and exterior views, dimensions, selection chart and specifications. 8-page bulletin No. WQ-50. Warren Steam Pump Co, Inc, Warren, Mass.

B42 **VERTICAL TURBINE PUMP**—Describes Class APH-APK line of vertical, turbine-type pumps particularly applicable to bulk liquid transfer, cooling tower, dewatering and similar services where suction is taken from an open source. Pumps range in size from 6 to 30 inches. 8-page catalog No. 7228. Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

B43 **CENTRIFUGAL SUMP PUMP**—Covers Types VS and VN centrifugal sump pumps available in wet and dry pit types. They handle clear liquids, sewage and other liquids containing solids, in eight sizes, 1¼ to 8 in. 8-page bulletin No. 220. Warren Steam Pump Co, Inc. Warren. Mass.

PRIME MOVERS AND ACCESSORIES

B44 **DIESEL ENGINE** — Describes Type FV diesel engines built in 6, 8, 12 and 16 cylinder types for locomotive service, draglines and electric power generation in industrial plants. Engineering data, specifications and power ratings. Bulletin No. FV-63. Cooper-Bessemer Corp, Mt Vernon, Ohio.

B45 **GAS TURBINES**—Contains information on a gas turbine designed for centrifugal compressor drive for pumping natural gas. Included are features, application and operation data together with line drawings, charts and photographs. 16-page bulletin No. GEA 5530. General Electric Co, Schenectady 5, N. Y.

WATER TREATMENT

B46 **UNDERDRAIN SYSTEM** — Describes a multi-plate underdrain system which channels the upflow horizontally when backwashing a water purifying plant. Typical installations and specifications are given. 4-page folder No. 5128. Layne & Bowler, Inc, Memphis 8, Tenn.

B47 **PRODUCTS AND PROCESSES**—Presents case histories of typical process applications together with brief descriptions of the equipment. 12-page bulletin No. 50-1. Infilco Incorporated. Box 5033, Tucson, Ariz.

B48 **CORROSION CONTROL**—Covers the causes of return line corrosion and Dearborn's corrective treatments, Formula 700 and 702. Also includes test procedures for both treatments. 4-page bulletin No. 5013. Dearborn Chemical Co, Merchandise Mart Plaza, Chicago 54, Ill.

WELDING

B49 **WELDING CHART**—Reference chart gives the recommended schedules for spot welding low carbon steel. Standard size. Ampco Metal, Inc, 1745 S 38th St, Milwaukee 46, Wis.

B50 **BRAZING ALLOYS** — Discusses the current applications and de-

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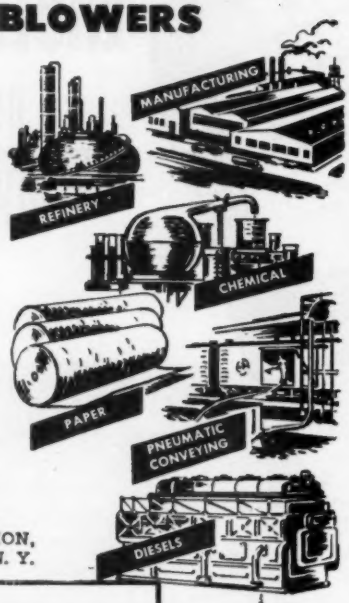

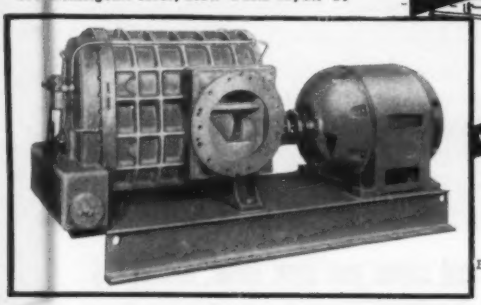

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velopments of Easy-Flo and Sil-Fos low temperature silver brazing alloys. 4-page bulletin No. 54. Handy & Harman, 82 Fulton St, New York 7, N. Y.

OTHER EQUIPMENT

B51 MERCURY CLEANING — Discusses mercury cleaning with mercury Oxifiers and gold adhesive filters. Principles of operation and the various sizes and capacities of units are described. 4-page folder. Bethlehem Apparatus Co, Hellertown, Pa.

B52 INDUCTION HEATING AND MELTING—A selector chart for induction heating and melting and a heating and melting speed table for standard induction equipment are features of bulletin. Illustrations of applications and case-history descriptions of installations also included. 8-page bulletin No. 27A. Ajax Electrothermic Corp, Ajax Park, Trenton 5, N. J.

B53 GRINDERS AND ARBORS—Information on a complete line of ball bearing bench grinders, arbors, sanding discs and face plates. Includes specifications, dimensional diagrams, and application suggestions. 8-page bulletin. Poly Products, 2032 E Walnut St, Pasadena 8, Calif.

B54 ATOMIC DEFENSE — Booklet, "How To Prepare Your Plant for Atomic Attack," presents factual information about the atomic bomb, its destructive potential, and its limitations. Also gives recommendations for strengthening plant construction and sustaining production in case of attack. 32 pages. Walter Kidde & Co, Inc, Dept A, 675 Main St, Belleville 9, N. J.

B55 CONSTRUCTION PROJECTS—Shows action shots of Donovan projects in the electrical, mechanical, constructon, manufacturing and management fields. 40-page booklet. Donovan Companies, 1725 Carroll Ave, St Paul 4, Minn.

B56 VOLTAGE REGULATORS—Covers single-phase inductrols for indoor service, 600 volts and below on circuits 3 to 240 kva. Hand, motor or automatically operated. Given are features, application and operation data together with sketches, line drawings, and charts. 18-page bulletin No. 795. General Electric Co, Schenectady 5, N. Y.

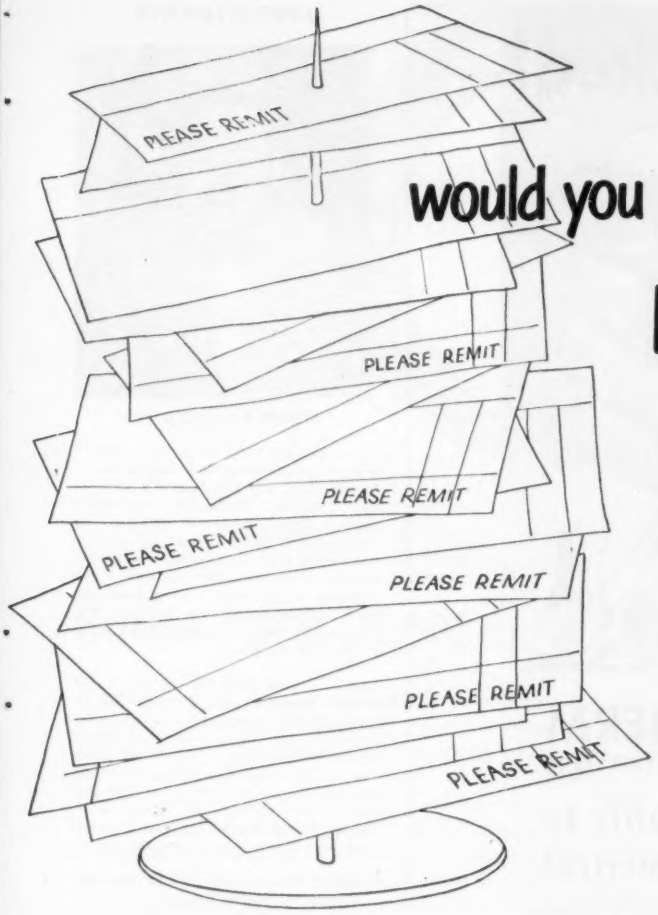
B57 INDUSTRIAL-WASTE TREATMENT—Contains a discussion of four ways to reduce industrial waste by (1) reducing volume of waste, (2) improving processing methods, (3) converting wastes to byproducts, and (4) treatment of wastes. 6-page bulletin. Gilbert Associates, Inc., Reading, Pa.

Natural Gas Coming To 125 New Cities

Current construction of 7618 miles of new natural-gas pipeline, involving record expenditures of $630,000,000, will bring new or additional service this year to homes and industries in 125 cities of 50,000 or more population and neighboring areas.

In addition to construction now under way, as authorized in 1950 by the Federal Power Commission, the fourth annual pipeline survey of the Gas Appliance Manufacturers Assn also revealed that major applications involving an additional 15,866 miles of pipeline, to cost an estimated $943,640,000, awaited hearing and disposition by the Commission on January 1, 1951.

Current proven recoverable reserves, as estimated jointly by the American Gas Association and the American Petroleum Institute, the GAMA study reported, are at 185.6 trillion cubic feet—5.2 trillion over reserves of the preceding year—despite 1950 record consumption of natural gas.



would you pay 16 times FOR THE SAME CONTROL SYSTEM?

Of course you wouldn't — but maybe you *do*.

Let's consider a few figures. At a conservative estimate, a good boiler will give you 200,000 hours of service. If it is a 100,000 lb/hr boiler it will burn during that time not less than $8,000,000 worth of fuel—even at today's prices.

If, through failure of your control system to give maximum combustion efficiency, you waste as little as *one per cent* of that fuel, your control system will have cost you $80,000—in addition to what you paid for it originally.

You will still have the same control equipment but you will have paid for it *sixteen times* over!

With a system by Hagan, you pay for your control just *once*.

Hagan Automatic Combustion Control is designed for *precise* control. When it is placed in service, it is adjusted by Hagan's experienced combustion engineers, who make sure that you get the precision which is built into the control system.

Then, by way of extra dividends, Hagan gives you *long life* and *low maintenance*. The ruggedly built components of the Hagan system last as long as the boiler—and longer.

Hagan controls are used on every size of boiler from 5,000 pounds per hour at 3 psi to 1,340,000 pounds per hour at 1800 psi. They have been applied to boilers burning oil, coal, gases of various types, sawdust—and always with satisfactory results.

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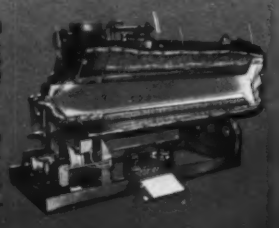
Cyclonic Combustion, an exclusive Cyclotherm method, is literally years ahead in economical steam generation.
Just Think: Steam, to full operation, in 15 to 25 minutes!
Burns fuel so completely you not only save many dollars in fuel bills but are assured of complete cleanliness.
No smoke or soot from Cyclotherm Cyclonic Combustion.
Proven statements of maintenance alone show 30% to 50% saving.

Boilers are designed for oil or gas operation from 18 thru 500 h.p., 15 to 200 lbs. operating pressure.

Your phone book will give you your Cyclotherm man's address. Or write for booklet on Cyclotherm Combustion to Dept. M.



CYCLOTHERM CORP., OSWEGO, NEW YORK

APPOINTMENTS

ROBERT M HATFIELD, JR

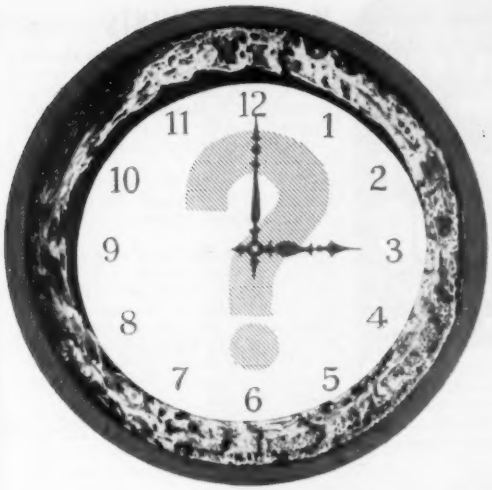
Robert M Hatfield, Jr, western general manager of **Combustion Engrg-Superheater, Inc,** and until recently chief of the National Production Authority's (NPA) Power Equipment Division has been named vice-chairman for government agencies of the munitions board. He will also serve as executive assistant to the chairman of the board, John D Small. In his new job, Hatfield will be top liaison man between defense agencies and regular government bureaus.

Executive promotions by the **De Laval Steam Turbine Co,** Trenton, N. J.: James P Stewart, former executive vice-president, has been elected president. Wencel A Neumann, Jr is now vice-president of industrial sales. H G Bauer has been elected v-p of engineering and will continue as manager of marine sales. Charles A Jurgensen becomes v-p of manufacturing and continues as works manager.

Robert E Husteiner was elected president of **Cummins Engine Co, Inc,** Columbus, Ind. to succeed J Irwin Miller who becomes chairman of the board. Clessie L Cummins, founder and former chairman, was named honorary board chairman.

Worthington Pump and Machinery Corp has named A H Borchardt a vice-president with overall responsibility for the sale of the entire line of pumping equipment. Herbert E Callison succeeds J C Lukas as manager of the industrial mixer sales div at Dunellen, N. J. W Clifford Mumford and Fenmore E Dunn have been made manager and assistant manager of vertical turbine pump sales div at Harrison, N. J. Herman H Miller, manager of compressor div, who plans to retire soon, has stepped down to act as consultant to his successor E A Murray. Company's water treating section from Dunellen to Harrison, N. J.

J C Linsenmeyer, works manager, has been elected vice-president in charge of manufacturing of the **American Blower Corp.** John Brennan was appointed chief engineer; E W Petersen becomes assistant general sales manager and Benjamin Ragland manager of hydraulic coupling div.



What Time This Month Will Boiler Tube Deposits Shut Down Your Plant?

It can happen *any day . . . any minute.* Deposits may be forming in your boiler tubes *right now* . . . adding layer on layer . . . building up for the failure that is sure to come!

When it does come, you can be sure of one thing. It's going to be expensive! Not only will replacement and installation costs be higher, but you'll also lose valuable production time. And unless your deposit problems are solved, it can happen again and again!

Drew Water Treatment will prevent the formation of deposits. Drew Service protects boilers and power plant equipment with a 3-point program that works! Here's what it does:

1. Drew engineers make a thorough study of plant operations and water problems.
2. Drew water chemists and engineers analyze this data in the modern Drew Laboratories and make specific recommendations for treatment.
3. Drew engineers make periodic service calls at your plant to insure the efficient and economical performance of your water conditioning.

Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew Boiler Water Treatment and Service. Do the same. Consult the nearest Drew engineer or write for information.

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How to reduce OIL CONTENT below

1/10 part per 1,000,000

...in condensate and process waters

Are you discarding oil-contaminated water... or re-using it without adequate purification? If so, you may find filtration with Sorbo-Cel a relatively simple, inexpensive solution to your problem.

Easy, low-cost clarification...

Sorbo-Cel is a specially processed diatomite powder. Used in conjunction with any standard screen-type filter unit, it provides a fast, easy and inexpensive way to absorb emulsified oil and other impurities from water. Total processing costs (including both material and operation) are only from 1¢ to 3¢ *per 1000 gallons.*

How Sorbo-Cel works...

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through the filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through. Oil removal is virtually complete—less than 0.1 ppm remaining.

Other important advantages...

In addition to trapping out oil globules, Sorbo-Cel filtration removes suspended solids such as rust, scale, and clay. Boiler-tube life is increased, scale formation is reduced, and shutdowns are less frequent. In plants using graphite or wet-steam lubrication to keep condensate oil-free, this method permits a return to the more efficient oil lubrication—with resultant economies in ring wear.

For further information about Sorbo-Cel filtration, use the coupon below.

Johns-Manville SORBO-CEL®

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name _____

Company _____

Address _____

City _____ State _____

POW-19

More APPOINTMENTS

Begins on page 226

John J Alexander has been appointed superintendent of **Republic Steel Corp's** Cleveland district steel plant to succeed Harry Stott, retired after 36 yr service.

John T Edelen has been appointed sales engineer for the Cincinnati office of **Dravo Corp's** machinery division.

Iron Fireman Mfg Co, Cleveland, O. appoints B B Magee director of U. S. sales and J M Mackay, former plant manager of the Toronto plant, is director, executive vice-president and general manager of the Iron Fireman Mfg Co of Canada Ltd. E V Crossin is manager of the new southern regional office in the Haas-Howell Bldg, Atlanta, Ga.

Elgin Softener Corp, Elgin, Ill. announces Ben F Willey is now industrial sales manager and V J Flood is now field sales supervisor.

Rene D Wasserman, director of research and president of **Eutectic Welding Alloys Corp,** Flushing, N. Y. is appointed to research committee of National Assoc of Manufacturers.

Cooper-Bessemer Corp promotes Thomas E Eagan to the new position of research metallurgist to study nodular iron and other engineering materials.

Oliver Iron and Steel Corp, Pittsburgh, Pa. has acquired **Berry Motors, Inc** of Corinth, Miss., which will be operated henceforth as the Berry Division of Oliver Iron and Steel Corp. Frank Berry becomes director of research of the div and former Berry president Ara A Cambere was elected vice-president in charge of div.

W F Wilson, general sales manager, **Lebanon Steel Foundry,** Lebanon, Pa. has been elected president of the Alloy Castings Institute.

Dowell, Inc has added E W Hudgens to its staff as development engineer specializing in cathodic protection of buried and submerged materials.

Westinghouse Electric Corp names S J Merriman assistant to the general manager of the company's East Pittsburgh divisions.

James F Dollison has joined the **Republic Rubber Div, Lee Rubber & Tire Corp,** Youngstown, O. as field engineer.

Youngstown Sheet and Tube Co has appointed John E Ward chief inspector for the Youngstown district to succeed Lewis W Fogg, Jr who died May 14.

Heman R Powers of the **National Aluminate Corp** has been promoted to the newly created post of Industrial Dept Field Manager. I A Clausen replaces him as district manager of the Pittsburgh territory.

David C Prince, **General Electric Co** vice-president on the president's staff and for-

For **TOP EFFICIENCY INSULATED PIPING SYSTEMS**

UNDERGROUND OR OVERHEAD

Ric·wiL *is your* BEST CHOICE

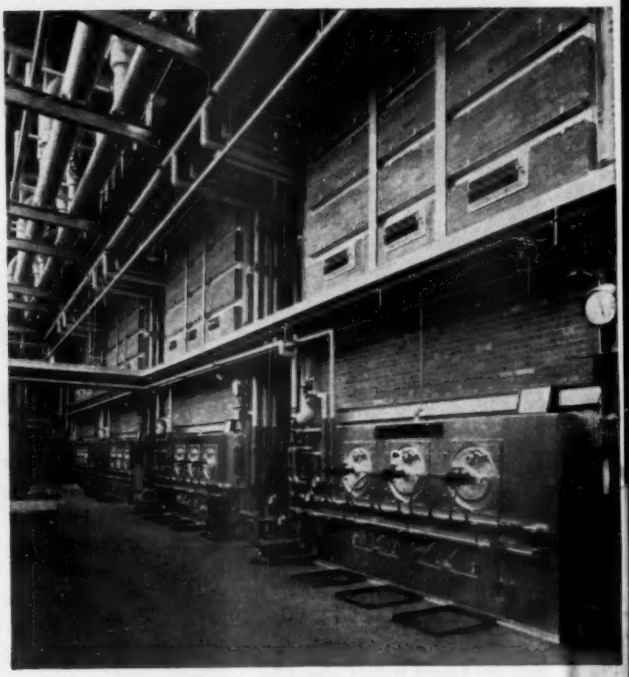
For distribution of steam or hot water, oils or process liquids, Ric-wiL Prefabricated Insulated Piping will provide your piping system with maximum sealed-in protection and efficiency.

Architects, engineers, and contractors have long recognized the reliability of Ric-wiL engineering and manufacturing of high-efficiency insulated piping—factors that insure long trouble-free life of industrial, commercial, and residential piping systems.

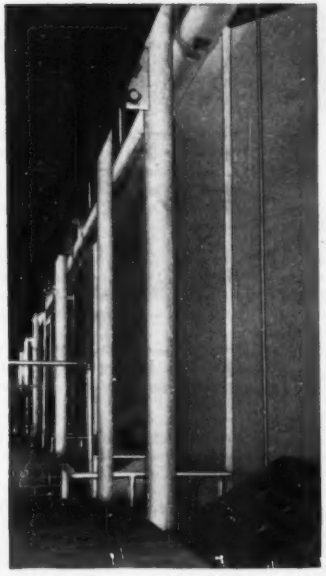
THE RIC-WIL COMPANY
CLEVELAND, OHIO

Ric·wiL PREFABRICATED INSULATED PIPING — UNDERGROUND OR OVERHEAD

Boiler room of Buffalo State Hospital, Buffalo, N. Y. All boilers, heated equipment, and steam lines are insulated with "Featherweight" 85% Magnesia. Cold water pipes insulated with K&M Duplex.



More than four and one-half miles of steam lines



Partial view of smoke breeching insulated with "Featherweight" 85% Magnesia 3" blocks and finished with Asbestos cement.

OWNER: State of New York
ARCHITECT: Cornelius J. White, State Architect
GENERAL CONTRACTOR: The John W. Cowper Co., Buffalo, N. Y.
HEATING CONTRACTOR: Quackenbush Company, Buffalo, N. Y.
INSULATION CONTRACTOR: E. J. Eddy, Inc., Buffalo, N. Y.

—insulated with "FEATHERWEIGHT"® 85% MAGNESIA

From the new boiler house of the Buffalo State Hospital, 24,000 lineal feet of piping carry steam throughout the institution. And, to guard against heat losses, the entire system—pipes, boilers, smoke breeching, and other heated surfaces—is insulated with "Featherweight" 85% Magnesia.

"Featherweight" 85% Magnesia provides efficient, durable insulation at a cost that insures savings. And the savings are continuous; "Featherweight" will last the life of your heating system!

Keasbey & Mattison "Featherweight" 85% Magnesia Insulation is made in blocks, laggings, and standard-size pipe coverings for all applications up to 600° F. Other K&M Insulations cover service ranges from 40° F. to 1900° F. Our local distributor, who is an experienced applicator, will be glad to give you complete information. Or, write us.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

In Canada: **ATLAS ASBESTOS COMPANY, LTD., MONTREAL, TORONTO, WINNIPEG, VANCOUVER**

HERE'S WHY

TILCO-FIN CUTS THE COST OF HEAT TRANSFER

AS NO OTHER FIN TUBING CAN!

EXCLUSIVE!

- *segmented fins*
- *fused metal shoulder*

MOVE TWICE AS MUCH HEAT*

per unit of surface as any other type of fin tubing!

See how much TILCO-FIN will save in your plant

SURE, fin tubing is the best way to handle most heat transfer operations. Cost data from dozens of industries prove it—over and over again.

The important thing is to get the *best* fin tubing.

Cost data and independent testing provide a positive answer here, too—TILCO-FIN!

Millions of feet of this cost-cutting tubing are in use today, *setting economy records* for waste heat steam generators, air-cooled jacket water exchanges, air-cooled condensers, air-cooled lube oil coolers, gas heaters and coolers, instrument enclosure heaters, blast coils for space heating and cooling.

You can get all of Tilco tubing's exclusive advantages on large jobs or small, a tailor-made installation that will *transfer twice as much heat per unit of surface!* The fused shoulder eliminates costly heat loss due to interfaces of dirt, air and corrosion common on other types of tubing. It's a rugged, welded fin bond that *will not break!*

Chemical and Power Engineers Valuable New Handbook FREE!

Get all the facts about this modern way to multiply your savings on heat transfer jobs. This newest fin tubing reference source puts everything you need to know about extended surface equipment right at your fingertips in accurate easy-to-use form. Just clip the coupon below to your letterhead and mail today!

12 page, file-size booklet. Tells you how to choose and use fin tubing to best advantage. Includes data tables, graphs, charts, nomograms.

*Proved in independent comparison tests by Norris and Spofford, Transactions of the ASME, July 1942

TILCO-FIN DIVISION, Kentile, Inc.
58 2nd Ave., Brooklyn 15, N. Y.

Please send me, without charge or obligation, a copy of the Tilco-Fin Tubing Handbook.

Name_____

Firm_____

Street_____

City_____ Zone_____ State_____

More APPOINTMENTS

Begins on page 226

mer head of company's general engineering and consulting laboratory, has retired after 32 years of service. Past-president of the AIEE, recipient of the AIEE Lamme medal in 1940 and holder of 98 U. S. patents, Mr. Prince will enter the consulting engineering field with headquarters in Schenectady.

Other GE announcements include: Dr. Louis T Rader to manager of engrg of the controls div at Schenectady with Harry L Palmer as assistant to the manager and Benjmain Cooper as division engineer of the electronics and regulator engrg div; William E Saupe to operation manager and Will Pruessman to manager of manufacturing of the Schenectady steam turbine and generator div; F S Kohl to operation manager of Fitchburg turbine div; A T Chandonnet to manager of Lynn (Mass.) turbine div; J Herbert Behm to assistant to the manager of engineering on special assignments, fractional horsepower motor engrg div at Ft Wayne, Ind., with L R Beard as division engineer of ac motor engrg div, R D Jones as div engineer of development engrg and I E Ross as div engineer of dc and specialty motor engrg; L M Stauffer to manager of the Rocky Mountain apparatus district, Clayton S Coggeshall to assistant to the manager and Robert S Neblett to manager of sales for the turbine divisions; William V O'Brien to manager of the apparatus marketing div; C F Coffin to Atlantic district representative handling conduit products and J F Nounnan to the Central district handling the full line of construction materials.

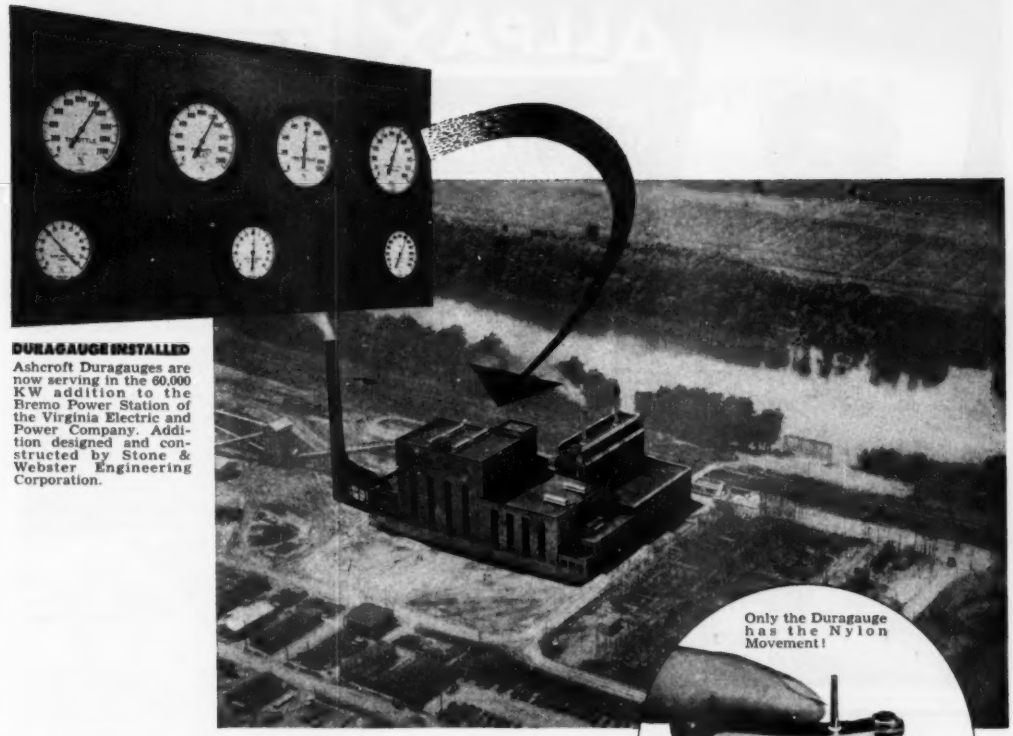
Union Electric Co vice-president Stanley Stokes has been assigned to general supervision of company's activities in connection with the joint Union Electric-Monsanto Chemical Co study of atomic power production.

Bruce R Wright, John T Odbert and Michael J Toth have joined the steam specialty div of the **V D Anderson Co** to head up development work on purifiers.

Helicoid Gage Div, American Chain & Cable Co, Inc appoints Vincent Lysaght sales manager with John Morrison product manager.

Prat-Daniel Corp announces the completion of its move to a new plant in South Norwalk, Conn.

Kaylo Div, Owens-Illinois Glass Co, Toledo, O. announces: A V Baber to manager, heat insulation sales; H E Casey to manager, structural product sales; P W Boyd to supervisor of laminated products; E C Shuman to director of research and manager of product development; W R Lugar to general branch manager as well as present title of manager of sales control; Anthony J Tyseen to sales engineer, Philadelphia office; Robert P Long to insulation engineer. Also, John Duncan, Jr, director of trade relations for the parent firm, has been appointed temporary consultant of the production control staff of the National Production Authority.



DURAGAUGE INSTALLED

Ashcroft Duragauges are now serving in the 60,000 KW addition to the Bremo Power Station of the Virginia Electric and Power Company. Addition designed and constructed by Stone & Webster Engineering Corporation.

☑ **Sustained Accuracy** ☑ **Improved Sensitivity** ☑ **Longer Service Life**

THE ASHCROFT *Duragauge* ASSURES ALL THREE!

Eliminate excessive weight and mass of parts in designing a pressure gauge and you achieve new standards of accuracy, sensitivity and service life.

Ashcroft engineers attained these objectives in the Duragauge *Nylon Movement**. Bearings and pinion gear are light, strong, dimensionally stable *nylon*. Friction and wear are minimized. Resistance to corrosion is increased. Shock impact absorption is improved. Advantages to you: sustained accuracy, greater sensitivity, low maintenance and longer service life. The Ashcroft Duragauge, with Nylon Movement, outwears all others.

Since its introduction in 1947, the Nylon Movement has been widely recognized for unmatched performance in "killing" services in power stations, refineries and chemical plants. Ask your Ashcroft Distributor for all the facts. He will gladly help you select the right Duragauge for your specific needs.

* Patented

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

ALLPAX

"The Packing that Packs All"
STYLE No. 14 outperforms in oil refinery service.

There's an ALLPAX Packing for every specific purpose. Style No. 14, recommended for centrifugal pumps, valves and swing joints, is widely used in handling high octane aviation gasoline, light and heavy oils, greases, benzol, etc. It can be used on temperatures up to 700°F. Made in sizes from 3/16" to 1¼", this self-lubricating packing maintains its resiliency, stops leaks, eliminates friction and scoring and assures maximum efficiency and minimum attention.

Also:

Valve Discs; Sheet Packing; Retainer Packing; Molded and Mandrel Cut Packing Rings; Packing Hooks; Gasket Cutters.

Other Packings in the ALLPAX line are designed for such services as general utility, chemical, food, wood pulp, paper, etc.—a type for each specific service.

ALLPAX Packing quality is being maintained in spite of material shortages. Consult your nearest distributor. Ask for Catalog describing the complete ALLPAX line.

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.

NICHOLSON W. O. TRAPS

STOP COSTLY LOSS

OF STEAM AND AIR

With cost of steam and compressed air steadily increasing, these 3 leak-proofing features of Nicholson weight-operated traps are proving important cost-cutters in many plants:

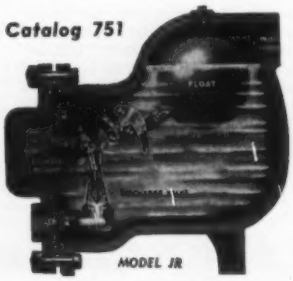
1) No air-wasting vent, such as is in all inverted bucket traps.

2) Positive water seal at valve. A Nicholson W. O. trap cannot lose prime and leak live steam.

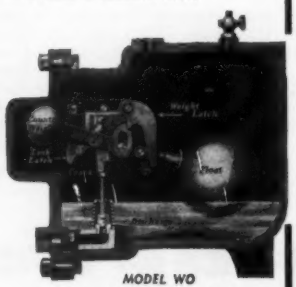
3) Large orifice keeps valve clean, preventing blow-through.

Three types, for pressures to 1500 lbs. Working parts of stainless steel.

Catalog 751



MODEL JR
for steam, air press. to 200 lbs.



MODEL WO
for steam, air press. to 650 lbs.

W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.

More APPOINTMENTS

Begins on page 226

Pennsylvania Flexible Metallic Tubing Co, Philadelphia, Pa, names: William Townsend to vice-president from vice-president in charge of sales; Charles W Strine to treasurer from controller; Charles W Young to vice-pesident of manufacturing from plant poduction manager and Emil Haegele to master mechanic.

Douglas J Donohue has been appointed Atlantic District sales manager for **Trumbull Electric,** Department of General Electric Co, Plainville, Conn. with offices in Philadelphia, Pa.

Monsanto Chemical Co elects J L Christian vice-president from general manager of the phosphate div.

The **Airetool Mfg Co** has recently acquired the **Ajax Expander Co,** Fairview, Pa. and has moved Ajax manufacturing facilities and inventory to its Springfield, O. main plant.

John W James has been made vice-president in charge of research for **McDonnell & Miller, Inc,** Chicago, Ill.

Charles W Bowden, Jr has been named chemical industry manager for the **Brown Instruments Div, Minneapolis-Honeywell Regulator Co.**

I Melville Stein, director of research, **Leeds & Northrup Co,** has been elected to the newly created post of executive vice-president.

Robert M Lundren has been appointed vice-president of the **Kuljian Corp** in charge of their sales program.

Allis-Chalmers names F T Sagemiller assistant to the production control manager, general machinery div, West Allis works.

Russell J Wolf has been named vice-president in chrage of sales and Donald W Champlin, vice-president in charge of manufacturing for the **M W Kellogg Co.**

Dr Fred F Fleischman has been appointed sales engineer for the **Corning Glass Works'** plant equipment sales dept.

Clinton B Burnett has been appointed director of engineering of **Johns-Manville Corp.** A K Higbee has been appointed production manager of the building products div and a vice-president of the Johns-Manville Products Corp.

Conoflow Corp, Philadelphia, Pa. has appointed the Harold G Jones Co, 502 Empire Bldg, Pittsburgh as representative serving western Pennsylvania and northwestern West Va. M N Aitken Co, 5960 Kansas St, Houston, Tex, will represent them in the area from Freeport to Lake Charles, La.

Howard J Dauphinee has joined **Jenkins Bros** valve sales staff as representative covering northern Calif, working out of the San Francisco office.

HERE'S PROOF

FAST'S COUPLINGS cost you less to own and operate

ON BILLET MILL SINCE 1923

ON GAS BLOWER SINCE 1920

ON AMMONIA COMPRESSORS SINCE 1922

Fast's Couplings cost you less per year because they normally outlast the equipment they connect. That means their reasonable cost can be spread out over 20 years or more . . . assuring low-cost service without excessive maintenance costs!

Fast's basic design is *foolproof!* Instead of a perishable oil seal, Fast's are the only couplings to use a *permanent* metal-to-metal closure. Oil is always maintained at a safe level . . . whether the coupling is running or standing still . . . and dirt cannot get in. Fast's Couplings are compact, yet large enough to stand up under punishing service for 20 years or more!

When you specify Fast's Couplings, you get Koppers' valuable engineering service. In many cases where a special coupling appears necessary, Koppers engineers can modify a standard Fast's and save you money! Get the facts on Fast's Couplings. Mail the coupon for your copy of Fast's *free* Catalog today!

Mail Coupon for FREE Catalog

KOPPERS CO., INC., Fast's Coupling Dept.,
229 Scott Street, Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name.....

Company.....

Address.....

City.....Zone.....State.....

KOPPERS

FAST'S

THE ORIGINAL GEAR-TYPE

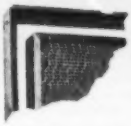
Couplings

INDUSTRY'S STANDARD FOR 31 YEARS

Here's why...

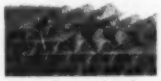
FAR-AIR* FILTERS

are unequalled in Quality, Construction and Performance



16 gauge filter and holding frames assure well-aligned, rigid filter banks. Interlocking holding frames are easy to install and the rugged construction prevents distortion. Felt liners effectively prevent air by-pass.

Reinforcing rods drilled through the media insure rigidity and add to service life.



Herringbone-crimp media design assures dependable higher performance, larger dirt holding capacity, lower pressure loss, easier cleanability, reduced maintenance costs. Media is packed firmly and evenly in the frame resulting in even density throughout the filter and assuring uniform high efficiency over the entire filter area.

You can be sure of a high performance air cleaning job when you specify Far-Air Filters. Precision engineering plus quality construction to rigid specifications assure *uniform* performance. Available in a wide range of types and sizes for dirt, lint, grease, entrained water, paint, ink, and many other air filtering applications. Contact your local representative or write direct to Farr Company, P. O. Box 10187, Airport Station, Los Angeles 45, California.

*Trade Mark Reg.

FARR COMPANY

Manufacturing Engineers

Los Angeles • Chicago • New York

M'f'd under license by Control Equipment Co. Ltd. Montreal

More Appointments

Begins on page 226

Kenneth S Thomson, presently executive secretary of the Cleveland Assoc of Credit Men, was elected president of the **Sterling Engine Co,** Buffalo, N. Y. Leslie D Calhoun will become vice-president in charge of engineering.

Struthers Wells Corp, Titusville, Pa. has appointed A W Burnite as chief engineer of its boiler division.

W B Connor Engineering Corp announces the appointment of Harold F Hagen as design and engineering consultant.

OBITUARIES

WILLIAM C JOHNSON

William C Johnson, executive vice-president of Allis-Chalmers Mfg Co, died suddenly July 26 at the age of 49, thus ending a brilliant career that began in 1924 when he first joined the company as a machinist helper. At the time of his death, Mr. Johnson had charge of both the general machinery and tractor divisions of Allis-Chalmers. He had been promoted to this post in Feb of this year following the death of President Walter Geist. Johnson had also served on the firm's board of directors since Jan, 1948 and was a member of the board's executive committee.

Wilbur R Brown, assistant head of the turbine test division of the River Works, Lynn, Mass. of the General Electric Co, died recently.

Dr Dugald C Jackson, 86, co-founder of the engineering firm of Jackson & Moreland, Boston, and former head of the electrical engineering dept of the Mass Institute of Technology, died at Cambridge, Mass. on July 1.

William E Herb, 61, vice-president and general sales manager of Gifford-Wood Co, died July 3 at the Columbia Memorial Hospital, Hudson, N. Y.

Alfred G York, a director and vice-president of the Watson-Stillman Co, Roselle, N. J., died July 22 at his home.

FREE BOOKLET

tells how to speed maintenance

THIS illustrated digest contains a wealth of sound, practical ideas to expedite Diesel maintenance, keep operating costs low and extend equipment life. Gives details on such subjects as:

- Cleaning filters
- Desludging lube oil coolers
- Descaling jacket water coolers
- Degreasing engine parts before repair
- Steam-detergent cleaning
- Plant maintenance cleaning

Manual also discusses tested Oakite procedures for streamlining maintenance in steam control stations and electric power plants.

FREE copy of this 16-page digest yours on request. Consult your local Oakite Technical Service Representative. Or write address below. No obligation.

OAKITE PRODUCTS, INC.

23 Thames Street, NEW YORK 6, N. Y.

Technical Service Representatives Located in Principal Cities of United States and Canada

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

NOW 3 GREAT PIPE INSULATIONS

Amocel

joins Unibestos in the UNARCO line of asbestos pipe insulations

...up to 650°F.

Answering the demand for a jacketed pipe insulation for use in the lower heat ranges, UNARCO now offers Amocel — for temperatures up to 650°F. Like Unibestos, Amocel is made of Amosite asbestos fibers bonded with an inorganic binder. For pipe sizes from ½" through 12", in Standard thickness only. Light in weight. Highly efficient. Durable.

UNIBESTOS ...up to 750°F.

UNIBESTOS ...up to 1200°F.

2 GREAT PIPE INSULATIONS — Unibestos No. 750 and No. 1200 — long have been America's outstanding insulations in their respective temperature ranges. Regular production for pipe sizes from ½" through 24" in popular thicknesses through 4". Other thicknesses and sizes available on order.

We want you to have our Catalog — It gives you complete information on Amocel and Unibestos Pipe Insulations; Unibestos Insulating Block; Cements and Finishes; Flexible Insulations; Metal Mesh Blankets; Tailored-to-Fit Insulations; Asbestos Packings and Gaskets; Asbestos Textile Products . . . Just drop us a line today, requesting that we send you UNARCO Catalog No. 76-109.

UNARCO

UNION ASBESTOS & RUBBER COMPANY

DEPT. 1819 • 332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS

BOILER TUBE CO. OF AMERICA

Tube Stocks and Bending

BOILER TUBE CO. OF AMERICA

McKEES ROCKS, PA.
(Pittsburgh District)

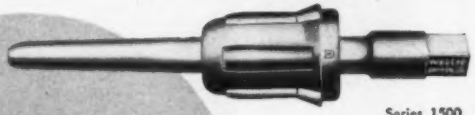
PITTSBURGH
CHICAGO

FRED S. RENAULD & CO.
LOS ANGELES

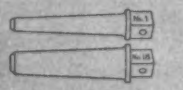
IDEAL

You'll Get More Efficiency with

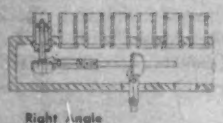
Series 1500 Tube Expanders



Series 1500



Short Mandrels



Right Angle Gear Drive

For installation and maintenance of tubes in drums, headers and similar water tube boilers.

A combination of short mandrels and right angle gear drive speeds up operation and assures efficiency with far less operator-fatigue. The new and smaller reinforced gear drive enters most hand-holes.

See Your Dealer or Write Us Today!

THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

Natural Graphite puts "MORE MUSCLE" into grease!

FOR EXAMPLE:

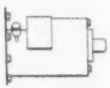
OPEN GEARS
rough treatment

CONVEYORS
moisture, corrosion

HOISTS
exposure to weather

STOKERS
high temperatures, dirt

CHAIN DRIVES
moisture, dust



COUPLINGS
heavy loads, moisture

In Fact:—for *all* applications where conditions of dirt, dust or moisture prevail.

What are *your* tough lubricating jobs...where *ordinary* greases take a beating? Try greases fortified with Dixon *Natural* Graphite. Then see the big improvement!

Why? Because greases combined with Dixon *Natural* Graphite provide outstandingly effective lubrication *under even severest conditions* ...where dirt and dust abound; rain and moisture; high pressures; temperature extremes; shock loads.

Dixon *Natural* Graphite is practically indestructible. It withstands extremes of heat and cold. It is insoluble. Inert, it is unaffected by acids and alkalies. Processed under closest laboratory control.

What is your toughest lubricating problem? Tell us the full particulars ... our technical department will analyze your problem and send you specific recommendations and a sample of the proper Dixon lubricant. No obligation. Write, Joseph Dixon Crucible Co., Jersey City 3, N. J.

DIXON
NATURAL GRAPHITE

trying to decide what fuel to use

perhaps Beacon Combustion Service*

can give you some outside information

* A service, by our technically trained representatives, designed to help you get MORE from your fuel. Available at no cost or obligation in areas covered by Beacon Coal Sales Offices.

When you're thinking of changing fuels . . . be sure you don't think only of the *disadvantages* of the old . . . and of the *advantages* of the new. The Beacon Combustion Service Man can be helpful at a time like this . . . with *outside* information that will help you reach a sound decision . . . and maybe save some money in the bargain.

FOR EXAMPLE: Large industrial plant used mixture of two coals for powdered-fuel-fired boilers. Had difficulties due to (a) dust from lower-cost coal, and (b) fineness . . . which affected air feed from pulverizing mill to furnace. Engineers decided to standardize on higher cost fuel: extra cost 60-cents a ton. B. C. S. Man recommended standardization on *cheaper* fuel . . . dust treatment (at 15 cents per ton) . . . and adjustment of fan to provide proper feed for the new coal. Net savings: 45 cents a ton . . . a potential pick-up of thousands of dollars in this instance.

FOR EXAMPLE: Apartment building contemplated change to liquid fuel, because of smoke problems. B. C. S. Man agreed trouble an inadequate combustion space . . . which would have created same smoke problem with new fuel. Fitting stoker eliminated difficulty, permitted continued use of lower-cost fuel.

It pays to spot the REAL source of difficulties or dissatisfaction before making any change that involves trouble and expense. The B. C. S. Man will be glad to survey your operation with you, help to pin-point the problem and suggest ways to correct it.

NOTE TO COAL DEALERS: If any of your commercial or industrial customers or prospects have a problem like this, our B.C.S. Man will be glad to work with you in determining the cause and recommending a solution.

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BEACON COAL

EASTERN GAS AND FUEL ASSOCIATES

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SOLVED! An Overhead PIPING PROBLEM

Babbitt —Adjustable— SPROCKET RIM with Chain Guide

• flange of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 39 inches.

• Operation of valves in overhead piping is no longer a problem. Put valves where they should be, where they'll be most economical or efficient, even if necessary to place them out of reach. Easy, safe, positive control is provided by the BABBITT Adjustable Sprocket Rim with Chain Guide—right from the floor!

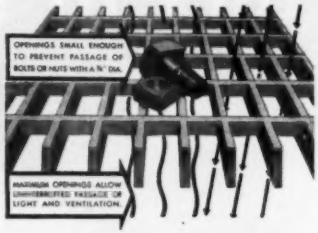
• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

BABBITT STEAM SPECIALTY CO.

1 Babbitt Square, New Bedford, Mass.

TRI-LOK RECTANGULAR OPEN STEEL FLOORING


OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ½" DIA.
MAXIMUM OPENINGS ALLOW UNRESTRICTED PASSAGE OF LIGHT AND VENTILATION

Tri-Lok strength is obtained by truss action through twisted cross-bar, curved in opposite directions at each bearing-bar. Standard openings in Tri-Lok Rectangular Steel Flooring are 1" x 3⅞"—other sizes can be supplied as required.

Diagonal, or Super-Safety U-type Flooring, and stair treads of all types, are available. Bulletin KF 1140 describes the construction features of Tri-Lok Open Steel Flooring.

The Tri-Lok Company is also equipped to furnish *riveted* and Tri-Forge *welded* open steel flooring. Tri-Lok grating can be furnished in a variety of metals, including aluminum alloy, stainless steel, etc.

DRAVO CORPORATION

National Distributor for the
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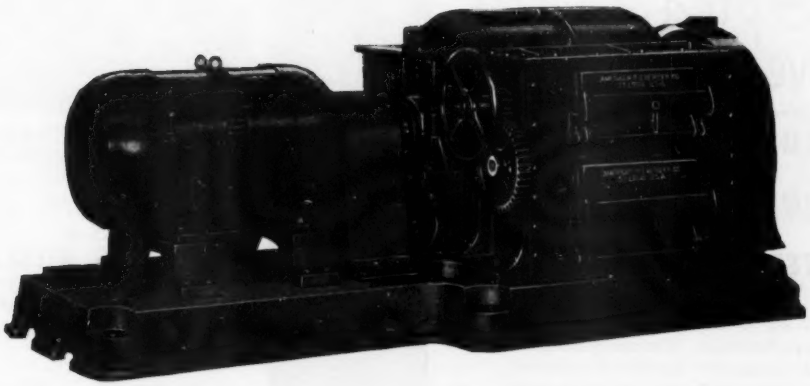
When you figure

COST PER TON

The best answers come from American

COAL CRUSHERS



Lower Repair & Maintenance Costs. Here are actual case histories:

- *4,000,000 tons of coal crushed at a parts replacement cost of only $.0005 per ton,* in ten years of operation at Illinois coal mine.
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Longer Life, Lower Depreciation. Many 20-year old Americans are still in active operation.

Lower Power Needs. American's exclusive patented Shredder Ring Crushing Principle permits slower speeds, resulting in new savings in power costs.

CRUSHES COAL FOR LESS THAN 1¢ PER TON—including Depreciation plus Maintenance plus Power plus Interest on Investment.

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for side vessel mounting

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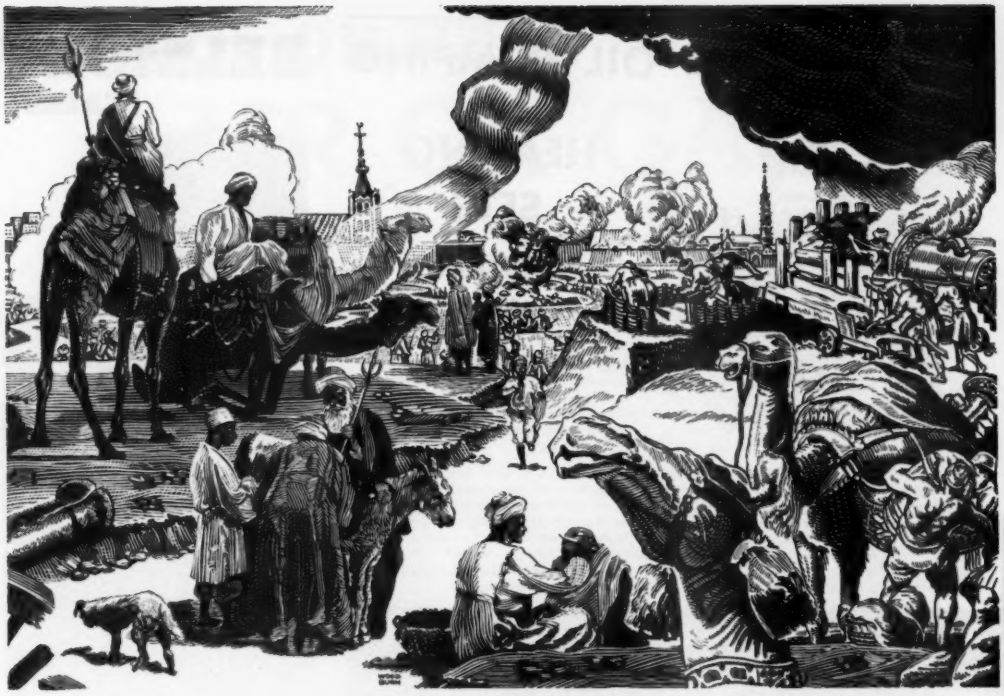

Steel saved civilization at Vienna

MODERN history begins with the record of conflict between Christians and Moslems--six centuries of wars that opened with the Crusades and saw the Turks capture Constantinople in 1453.

More than 100,000 Turkish janizaries and cavalry besieged Vienna in 1683. For two months, to quote the diary of an eye witness, "The enemy continued playing their cannon and granadoes. But the city walls were strong, Christian cannon were bigger and more numerous and ammunition more plentiful." Finally came a day when the officer's journal reported, "The enemy did not play their cannon so fast. It was confirmed that they had no great provision of bullets, inasmuch as they shot back not only our bullets, but also pummels of swords and all sorts of iron and stones."

At last a great Christian relief army was assembled. "They made an attack in the best order that ever army did. The enemy, forced always to give back, were put all into confusion. They betook themselves to flight, leaving all their provisions, ammunition, cannons and tents --the greatest part rendered unfit for farther use by our great guns."

Never again did the Turks seriously menace Christendom. Western civilization had been saved once more by its supremacy in the use of iron and steel. To aid our survival America's free private industry is producing steel at the highest rate ever known--and still expanding. The question remains--Will America use enough of this tremendous steel production to guarantee the continued supremacy of Western, Christian civilization?---We believe the answer is yes!

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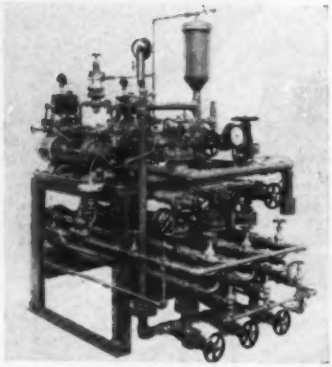
The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.

LOCKETT FUEL OIL PUMPING AND HEATING SETS *Custom Built*



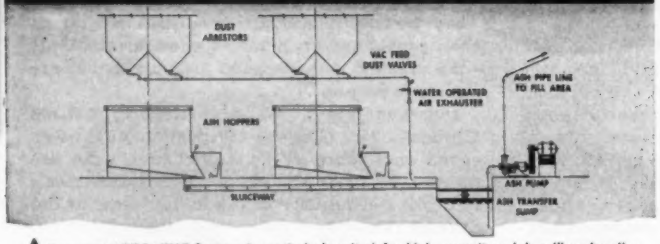
The compact, high-pressure unit illustrated consists of two Worthington Duplex Steam Pumps and three Griscom Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built Fuel Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump is suitable for the full rated capacity of the unit; and one heater section is a spare. Lockett supplies everything, complete. *Inquiries are invited. Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

Need Large Capacity Ash-Handling?

CHECK WITH BEAUMONT ON A HYDRAULIC ASH-HANDLING SYSTEM



A Beaumont HYDRAULIC System is particularly suited for high capacity ash-handling; handles wet ash or dry, molten slag and large clinkers; fits any type of power plant arrangement; is completely enclosed, preventing dust or gas from escaping to the boiler room; and can be operated by one man on a part time basis.

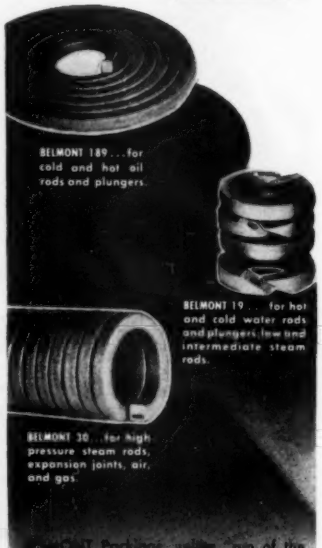
Beaumont's Ash-Handling Division is competently staffed to give you expert recommendations on all types of ash-handling systems . . . and to provide and install the proper equipment to suit your particular requirements. Write today for the Beaumont brochure: "Answers to Your Ash-Handling Questions".

Beaumont BIRCH COMPANY
1502 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—ERECTORS BUIK MATERIAL HANDLING SYSTEMS

IT WON'T *ESCAPE* . . . IF IT'S

BELMONT SEALED!


BELMONT 189 . . . for cold and hot oil rods and plungers.
BELMONT 19 . . . for hot and cold water rods and plungers, low and intermediate steam rods.
BELMONT 30 . . . for high pressure steam rods, expansion joints, air, and gas.

BELMONT Packings, unlike "run of the mill" packings, are the remarkable, trouble free, product of packing specialists who have devoted more than half a century to the problem of producing packings with a *Better Seal* and *Longer Life*.

Today, more than ever before, production schedules must be maintained without interruption. Your insurance against service interruptions and mounting maintenance costs due to packing failure is BELMONT; the Packing that will withstand the ravages of TIME as well as Steam, Water, Oil, Gas, Air, Alkalies, Ammonia.

There's a Belmont Packing for EVERY SERVICE . . . hundreds of styles enable you to select the correct basic raw materials and constructions to suit individual job requirements. Packed in the blue box with the orange colored trade mark, Belmont BETTER SEALING . . . LONGER LASTING Packings are available through distributors everywhere. RINGS, SPIRALS, COILS, REELS, SPOOLS, SHEETS and GASKETS. For special engineering help, write direct.

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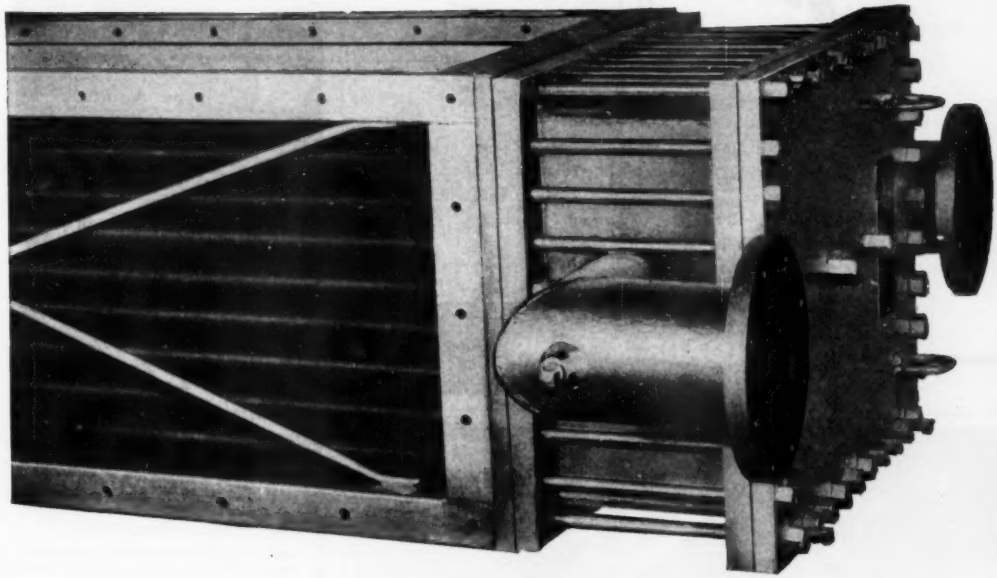
TO COOL OR HEAT
AIR OR GAS
....EFFICIENTLY



G-R K-Fin Units are admirably suited for air and gas cooling and heating duties. The use of K-Fin Elements with mechanically bonded helical fins, requiring no tinning, enables these units to withstand high temperatures and to operate successfully on duties where loosening of fins cannot be tolerated.

One of the distinctive features of the G-R K-Fin Cooler is its cooling surface of superior effectiveness. The K-Fin elements of this unit have helical fins. These fins, forming an extended outside tube surface, provide a higher heat transfer rate for a given air or gas pressure drop than is obtainable with other finned tube coolers.

When used as a *generator air cooler*, the K-Fin unit is embodied in a self-contained, closed, dust-proof and fireproof system, using turbine condensate or other available water supply as the cooling medium.

Some of the many other applications of this unit are for recovering gases from solvents, dehydrating illuminating gas, cooling gases from annealing ovens, and other gas cooling services.

Write for Bulletin describing all the features of the K-Fin Air and Gas Cooler.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

Experience Proves . . .

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offers more operating advantages and economies than any other means of power transmission on a great many applications. If you are planning new equipment it will pay you to investigate Tannate Flat Leather Belt Drives . . . available from ¼ HP to 2500 HP. We will gladly send you more details about Tannate, with engineering advice, if desired.

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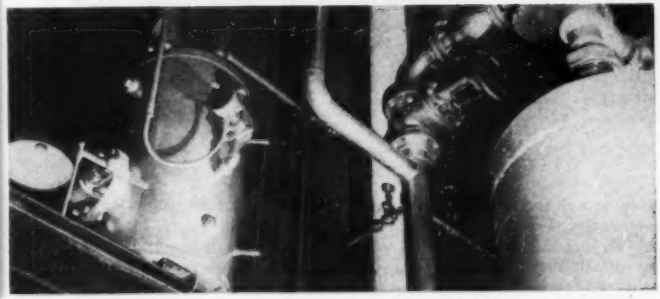

COCHRANE CONTINUOUS BLOWOFF

If you are using old-fashioned methods of blowing down boilers intermittently, you can save heat, save fuel, save money, maintain uniform boiler concentrations—and *get your money back inside a year*—by installing a Cochrane Continuous Blowoff System.

The savings are due, first to heat recovery by utilization of steam flashed from the blowoff and by directing the hot waste water (remaining after flash) through a heat exchanger. Uniform boiler concentrations, another result, mean smoother boiling conditions, cleaner steam.

Send for a copy of Publication 4410, containing chart for figuring savings by Continuous Blowoff.

SAVES HEAT
•
SAVES FUEL
•
SAVES MONEY

COCHRANE CORPORATION 3106 N. 17th St., Phila. 32, Pa.

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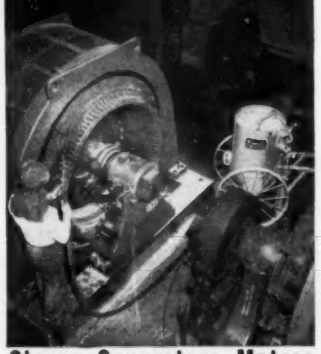
COCHRANE

PANGBORN AC-4

"CORN COB" Blast Machine



Cleans Generators, Motors

Faster Better Cheaper

Eliminates Toxic Hazard of Solvents!

THE new portable Pangborn AC-4 Blast Machine scours armatures, parts, frames, coils, etc. in ⅓ the time of other methods. Material costs are reduced 90% and toxic or explosive solvents are eliminated.

Look at the savings shown by this recent test on electric motors. (Name of Company on request.)

Cleaning Duplicate 500 hp Synchronous Motors

	Material	Labor
Solvent Method	$55.00	120 hrs.
PANGBORN Method	5.00	40 hrs.
SAVING	50.00 (90.9%)	80 hrs. (66.7%)

Remarks: With Solvent, drying period took an additional 8 hours.

SIMPLE OPERATION

New Pangborn AC-4 Blast Machines use standard 40-pound air supply to remove oil and greases with blast of soft, 20-mesh corncob grits. No residue left on parts . . . no drying period.

FOR FULL INFORMATION, write today outlining your operation. Address: PANGBORN CORPORATION, 90 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the Latest Developments in Blast Cleaning and Dust Control Equipment

Pangborn

BLAST CLEANS CHEAPER with the right equipment for every job

WE HAVE BEEN ASKED:

"What insulation do you recommend for a superheated steam line which operates at 1000° F.?"

"We are installing a 5" superheated steam line and plan to finish it with sewed canvas and paint to match existing lines," writes a power engineer. "What insulation do you recommend on a line like this?"

An efficient method of insulating this line would be a combination of Hy-Temp and 85% Magnesia Covering, each layer being 2" thick. Both layers of insulation should be applied with horizontal and vertical joints staggered so that there are no through joints where heat might escape. On high-temperature lines, this is important as it eliminates the possibility of heat's leaking through and burning the finish. Staggered joint construction also does away with the danger of fire in places where solvent fumes or other hazards are encountered.

With this construction, the layer of Hy-Temp Covering is applied first. This reduces the temperature at its outer surface to 600° F., the top temperature limit of the 85% Magnesia that is then applied to reduce heat loss further.

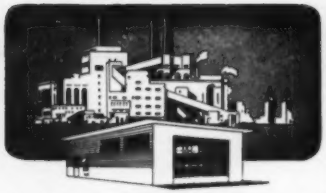
On many heat insulation jobs, there are places where proper application of materials can prevent burning of the finish, eliminate a fire hazard, or solve any one of dozens of other problems. Armstrong engineers can recognize those places before the insulation is applied and make the recommendations that will stop trouble before it occurs. The complete contracting service Armstrong offers also brings you top-quality materials and skilled workmen to apply them. The next time you have any insulation work to be done, it will pay you to get in touch with this reliable contractor.

SEND US YOUR QUESTIONS: If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write us. We'll do our best to give you a practical answer. Just address a letter or post card to Armstrong Cork Company, 7009 Maple Avenue, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2400°F.



Industrial Sound Control

QUIETS POWER PLANTS

ENDS ANNOYANCE COMPLAINTS
LOW EMPLOYEE MORALE
THREATS OF LEGAL ACTION
Due to Disturbing NOISE

Whether your equipment serves a city of millions, a small town, or just your own plant, ISC can solve the noise problem quickly and inexpensively. Investigate today.

Write, wire or phone us for full information on your problem

INDUSTRIAL SOUND CONTROL

45 Granby St., Hartford, Conn.

KEWANEE

HI-TEST

No1 WELD

For Power and Process Steam

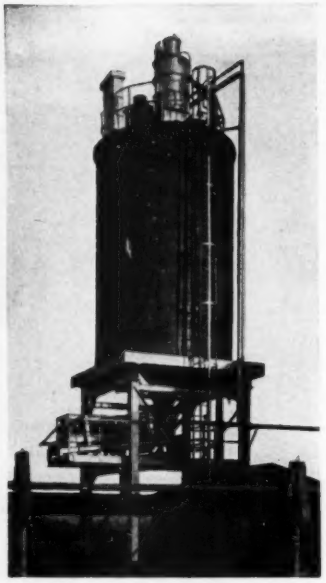
50 to 180 hp—125 and 150 lbs wp

Designed for easy handling, space saving and unusual economy . . . and built in full conformity with the ASME code for hi-pressure.

For any fuel . . . mechanically or hand-fired. Quickly and easily converted from one fuel to another.

WRITE Department 89-K9-549
for 6" scale with pipe diameter markings

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS



3 Years of Rugged Service for American Cyanamid

The National Ash Conveyor system shown was installed 3 years ago at The American Cyanamid Company plant in Newcastle, Pa. Its performance during this time is ample proof of the sound engineering and wear-resistant materials that go into our equipment. We now are installing a second unit at the Bridgeville plant of the same company.

NATIONAL — *"a good company to work with"*

National does not consider a completed installation its final responsibility . . . expert servicing for National Systems is always available. A free yearly check-up and quick delivery of replacement parts, from fully adequate stocks, is part of our service. A 25-year record for promptness and dependability has made strong friends of our many clients.

- *Send TODAY for informative catalog illustrating typical applications.*

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Manufacturers of The National ChipVeyor System For Metal Turnings—Furnace Doors—Feeders—Ash Gates and Related Equipment

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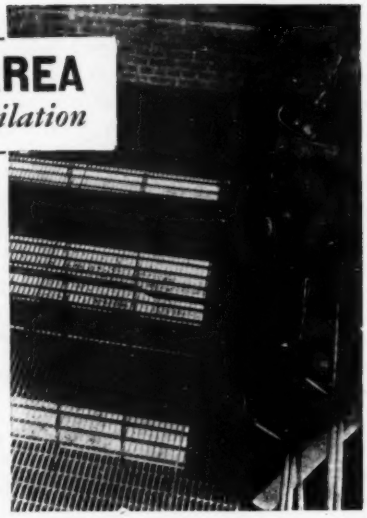
90% OPEN AREA
for light and ventilation



THE illustration shows the admission of light through three floors where the flooring is Hendrick Mitco.

Not only does pressure-formed Hendrick Mitco Open Steel Flooring have 90% open area, but there are no bolts, rivets or angle irons to collect dirt and refuse. The square-edge, uniformly spaced, rectangular steel bars provide a non-slipping, level walking surface.

1876—Seventy-Fifth Anniversary—1951

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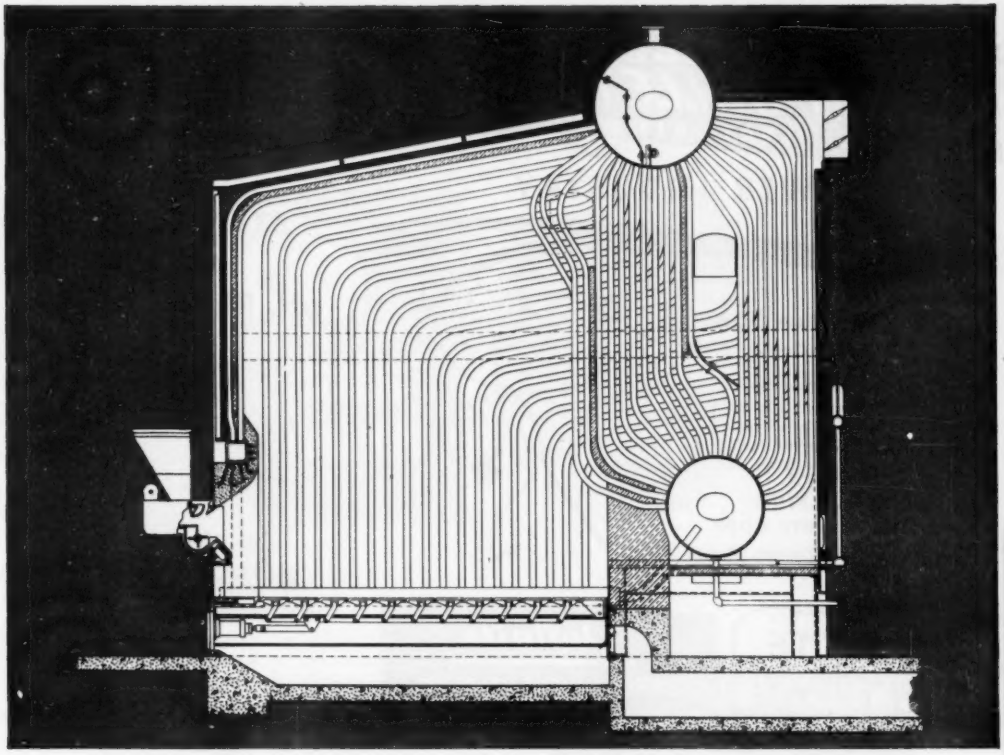
Manufacturing Company
46 DUNDAFF STREET, CARBONDALE, PENNA.
Sales Offices In Principal Cities

Perforated Metals
Perforated Metal Screens
Wedge-Slot Screens
Architectural Grilles
Mitco Open Steel Flooring,
Shur-Site Treads, Armorgrids



THE *V-C* 2-DRUM *High Capacity • Small Space*

COMBINING BOILER • WATER WALL FURNACE • INSULATED STEEL CASING

ERIE CITY concentrates high capacity into small space. The V-C Steam Generator has complete water cooling of top, sides and front, integral with a 2-drum boiler.

GAS travel is symmetrical about the center line of the unit.

WATER circulation is ring flow.

ONE or two internal steam separators, as required, assure clean, dry steam.

THE entire unit is supported from bottom members, thus allowing free expansion upward of the entire unit. All exterior walls consist of insulated steel panels, independently suspended, a construction similar to that of our largest central station steam generators.

ANY tube can be replaced without disturbing any other tube.

THE above illustration shows an Erie City Spreader Stoker fired V-C unit, utilizing a water cooled plastic arch, molded around the front header.

THE Erie City V-C Steam Generator is available in a wide range of capacities for varying space limitations and for all firing methods. Write for bulletin 37.

COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

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FEATURING
POWER INDUSTRY

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Entirely new, profusely illustrated, bulletins that contain information YOU NEED TO KNOW about water treatment, are now at our printers. . . . Reserve your FREE Special Copy by requesting on your letterhead:

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Refinite
WATER REFINING EQUIPMENT
OMAHA, NEBRASKA

Only Taylor Comparators give
PERMANENTLY GUARANTEED COLOR STANDARDS
for Testing
pH, Phosphate

Simply place reagent treated sample in middle tube in base, move the color standard slide until colors match and . . .

There's the Value!

There's no danger of mechanical inaccuracy when you use a Taylor Comparator for determining pH or phosphate in boiler water . . . because *all Taylor liquid color standards carry an unlimited guarantee against fading.*

One sturdy plastic slide houses all color standards necessary for any one determination. Each Boiler Water Set is packed in light-weight, convenient carrying case with base, slides, reagents and accessories. The utility of these sets is high, but their cost is low!

SEE YOUR DEALER FOR TAYLOR SETS

Also ask about the new Taylor Water Hardness Set that eliminates the time-consuming soap tests.

Write direct for your free copy of "Modern pH and Chlorine Control" if this valuable reference is not already in your library. Gives theory and practice of modern boiler water testing, describes and illustrates Taylor equipment.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO-4, MD.

How to read with your eyes open for business

Read the ads! Every issue of this magazine contains ads that offer valuable services and useful products by which your business may be run more profitably.

The time it takes to read all the ads is time well spent. One ad alone can pay off – by informing you of new developments and new sources of supply, by helping you do a more efficient job. For example, you may locate one machine that will cut your production costs, or step up your output. Or you may discover that the equipment you've been waiting for is now available.

This magazine displays more ideas and merchandise than a trade exposition. Make every issue your buyer's guide. Read the ads as well as the articles. That's reading with your eyes open for business.

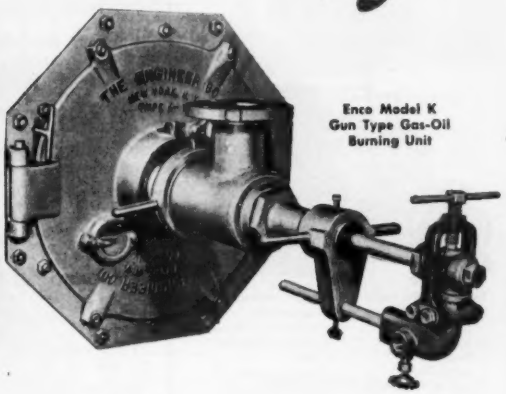
HEADQUARTERS FOR BUSINESS INFORMATION

McGRAW-HILL publications

F-22

flexible... 3 ways

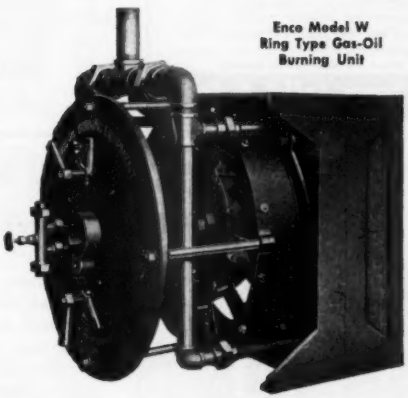
ENCO
OIL AND GAS BURNER UNITS



Enco Model K
Gun Type Gas-Oil
Burning Unit

These specially designed oil and gas burner units fit your needs . . . even when your operating conditions keep changing. Enco Oil and Gas Burner Units offer money-saving flexibility on three important counts. (1) They are designed for use with either oil or gas — or both . (2) They assure completely uniform combustion and greater fuel economy though steam demands swing sharply. (3) They can be operated by either natural or forced draft.

Even if your old combustion equipment "works", it pays to investigate the fuel-saving economies and full flexibility of these highly efficient units. Enco Burner Units are made in many sizes to suit all capacity requirements. Bulletin on request.



Enco Model W
Ring Type Gas-Oil
Burning Unit

ENCO
INTERCHANGEABLE ATOMIZERS
FOR USE WITH ALL TYPES OF BURNER EQUIPMENT

Wide Range Mechanical—Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Wide range. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical — Available in all sizes to suit load and capacity requirements.

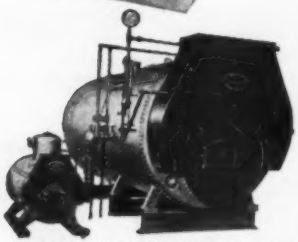
Enco Standard Range Mechanical Atomizer Gun
Enco Wide Range Steam Atomizer Gun
Enco Wide Range Mechanical Atomizer Gun
Enco Standard Atomizer Gun Support
Enco Gas Burning Gun

EC-493

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. RASKIN, LTD., 4230 IBERVILLE ST., MONTREAL 34 P.Q.

A DOZEN
STEAM BOILER POINTERS
FROM
LEFFEL...



Check off the boiler advantages that add up to economy in your plant operation!

√ Dependable
√ Self-contained
√ Compact
√ Easily Cleaned
√ Coal, oil or gas fired
√ 6 to 250 HP (actual)
√ Designed for overload
√ Rugged construction
√ Safe
√ Lowest operating cost
√ Easily maintained
√ Maximum combustion

Leffel's generations of boiler-making experience assure you that your next boiler will be your best — if it's a Leffel.

Write for descriptive catalog

The James Leffel & Co.
Established 1862

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IF you change your address,

please be sure to let us know promptly. It takes time to correct the stencil addressing plate. And we don't want you to miss copies of POWER.

Also . . . . . .

be sure to give us *both*

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and
(2) your NEW address.

We need them *both* to make the the change.

POWER

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PYREX sight glasses
BRAND
are most dependable

To see what you're doing, always insist upon Pyrex brand sight glasses!

Here is a glass that is compounded to give you high resistance to acids and thermal shock plus complete visibility over long periods.

Whatever you operate—ovens, furnaces, stills, evaporators, reactors, pressure kettles, etc.—you need the EXTRA VALUE that is afforded by Pyrex brand Sight Glasses. Available through your Industrial Supply Distributor.

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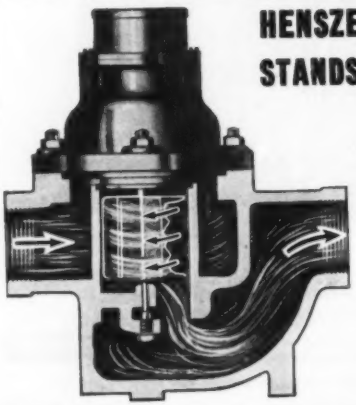
• 100 Years of Making Glass Better and More Useful •



HENSZEY *Feed Water* METER
STANDS UP *where others* FAIL

The cutting, abrasive action of hot, dirty Boiler Blowdown quickly breaks down meters that depend upon close clearances and intricate parts for their accuracy. Henszey Meters stay accurate—stay on the job—accurately measuring Boiler Blowdown, Feed Water, Condensate, Free-Running Chemicals and other "hard-to-measure" liquids. For details consult Sweet's Catalog or write:

HENSZEY CO., Dept. D9, WATERTOWN, WISCONSIN

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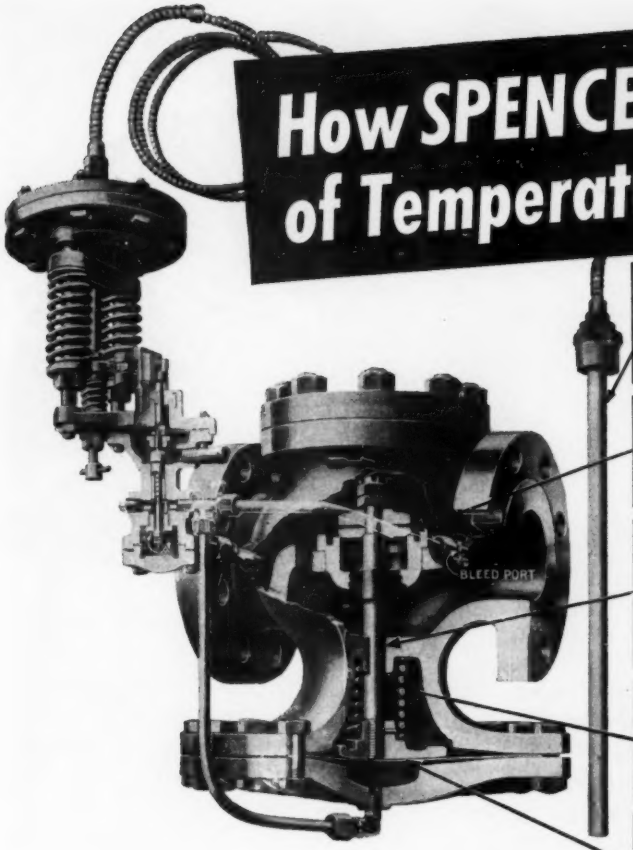
FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Boiler Feed Regulators • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

How SPENCE Cuts Costs of Temperature Control



NEW THERMOSTAT ELEMENT—Improved to practically eliminate loss of filling. Rugged construction; cannot be injured by overheating.

SECO METAL—Seats and discs are made of SECO Metal—guaranteed not to wire-draw.

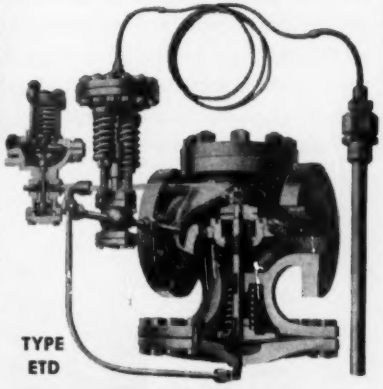
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

PROTECTED SPRINGS — Springs in the Spence Regulator are out of the path of the steam or other fluid flowing through the valve.

LARGE BALANCED DIAPHRAGM— Spence metal diaphragms, under usual conditions, never require replacement.

Accurate Control for Both Storage and Instantaneous Heaters

Spence Temperature Regulators reduce the steam pressure and also accurately modulate the flow as required to control the temperature. No separate reducing valve is necessary • The Spence ET150 Regulator is recommended for heater pressures up to 50 psi. For higher pressures the Type ETD is available • For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200.



TYPE ETD

SE 111

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

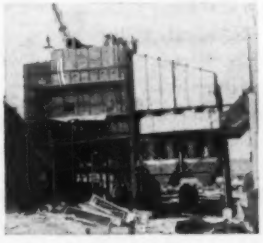
This 'dust' man can be your best friend

If you ask him about the Most Efficient, Most Economical Method of collecting Nuisance Dust

Wherever objectionable dust goes uncontrolled, you aggravate employee morale; you impair plant-community relations.

In either case, a Buell "dust" man can probably help. That's his job, and he is backed by more than 200 man-years of experience in solving industrial Nuisance Dust problems. We think you'll agree, too, that Buell's knowledge of dust is the reason why so many Utility and plant operators include us among their best business friends.

If you have questions regarding the latest advance in nuisance-dust Collection Equipment—its design, construction, and operating characteristics, a letter today will bring a quick reply. And—ask for the new, self-indexed Buell Dust Collection bulletin. Buell Engineering Company, Dept. 50-I, 70 Pine Street, New York 5, N. Y.



Buell van Tongeren Cyclone in series with Electric Precipitator provides high efficiency collection of Fly Ash at a large Eastern Utility.

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HIGH-EFFICIENCY CYCLONES
ELECTRIC PRECIPITATORS
'LR' COLLECTORS
LOW DRAFT LOSS COLLECTORS
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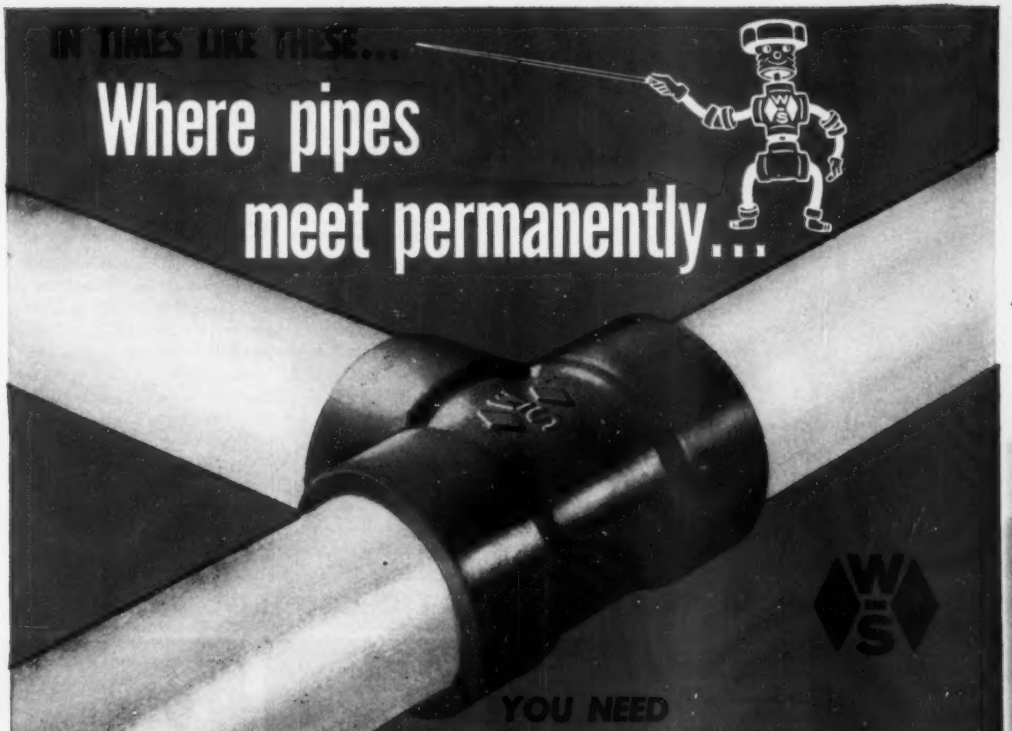
DUST HOPPER VALVES

ENGINEERED EFFICIENCY IN DUST COLLECTION

IN TIMES LIKE THESE...

Where pipes meet permanently...



YOU NEED

WATSON-STILLMAN

FORGED STEEL

SCREWED AND SOCKET-WELD FITTINGS

SCREWED FITTINGS . . . are designed with ample metal sections. The wall-thickness is faithfully observed in final manufacture. Extra long bands extend well beyond the last thread, providing reinforcement at points of severest strain. Threading — is long, accurately cut, and perfectly aligned to insure tight joints. All fittings are properly chamfered to protect thread and afford easy entrance of the pipe.

SOCKET-WELD FITTINGS . . . just slip over end of pipe and weld. Deep socket supports and aligns pipe, eliminates tack welding and the use of special fixtures. Accurate measuring and cutting of pipe unnecessary . . . Ample come and go. No welding icicles inside pipe — no clogged lines. Wall sections 1¼ times the nominal pipe thickness permits proper heat penetration and correctly positioned fillet weld.

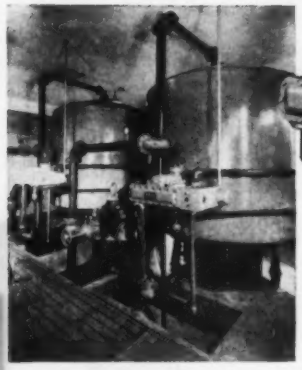
Basic materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and all are instrument inspected for perfection of threads, sockets, angles and concentricity. Write for Bulletin A3-50. For information on Stainless and Alloy Steel Fittings, Bulletin S-1.

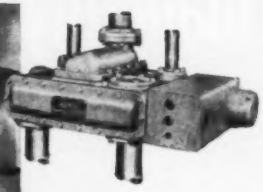
DISTRIBUTOR PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Sheers, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

FROM THE SMALLEST TO THE LARGEST IN THE WORLD

BELCO PROVIDES AUTOMATIC SOFTENING At Low Cost!

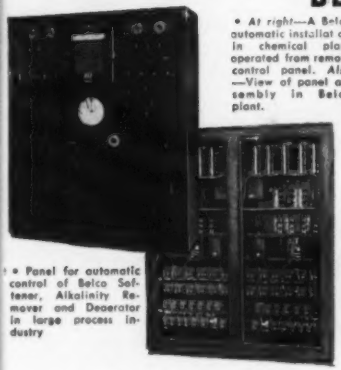




BELCO CAMOMATIC VALVE

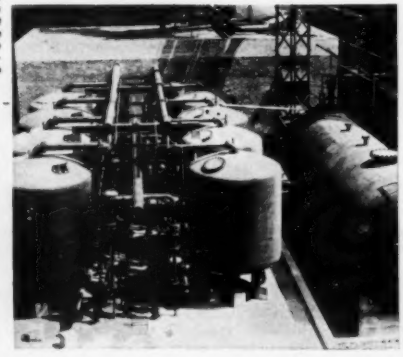
The new Belco Camomatic Valve completely eliminates the rubbing rotor, slam-action, high pressure loss and the stuck plug. No twisting, tortuous passages so pressure loss and corresponding pumping costs are at a minimum. Seats and discs are interchangeable. Simple construction enables any mechanically minded operator to make the replacement in a few minutes without breaking any pipe lines. Its smooth action requires only a small fractional h.p. motor. The Belco Camomatic Valve replaces the seven individual valves which are required for normal operation of a softener. When instruments indicate hardness present, or when a predetermined amount of raw water has been used, the softening cycle is automatically set in operation. The Camomatic Valve is also readily adaptable to pressure filtration and other process control. It can be rubber lined for the hydrogen cycle application where it is necessary to use acid instead of salt. A Belco engineer will be glad to discuss new applications as they may apply to your problems.

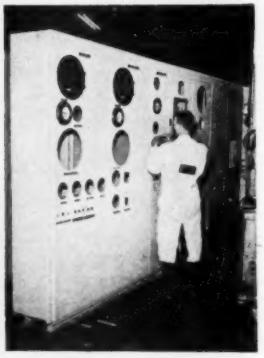
BELCO AUTOMATIC CONTROL PANELS



• *At right*—A Belco automatic installation in chemical plant operated from remote control panel. Also—View of panel assembly in Belco plant.

• Panel for automatic control of Belco Softener, Alkalinity Remover and Deaerator in large process industry



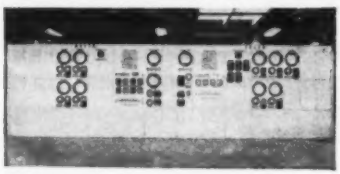


Belco Automatic Panel assemblies are designed and constructed in our own plant, under supervision of Belco electronic engineers. With a Belco control panel automatic control of a softening plant with visual indication of the valves programming is possible. Entire operation of back wash, regeneration, rinse and service return is automatically accomplished. Belco control panels are built too, for automatic control of process cycles in all industries. Large reserves of individual components of water softener and other special treating equipment are always on hand to insure most rapid fulfillment of your requirements. Ask a Belco engineer how modernization might effect substantial savings in your present operation. His experience is varied and complete.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.

PATERSON 3, NEW JERSEY

• Belco panel and controls used to operate the worlds largest demineralizing and silica removal plant.



PRODUCTS YOU CAN RELY ON—

WATER SOFTENERS: Hot Lime Soda, Belcolite, Gravity and Pressure Types, Automatic and Manual • **FILTRATION EQUIPMENT:** Gravity and Pressure Filters, Automatic and Manual Filters, Siliceous and Non-Siliceous Filters, Iron, Oil, Taste, Odor and Color Removal Filters • **SWIMMING POOL PURIFICATION EQUIPMENT:** Automatic and Manual • **DIATOMACEOUS EARTH FILTERS** • **COAGULATION EQUIPMENT:** Slow and Rapid Mix Agitators (Adjustable variable speed) Settling Tanks, Sludge Removers • **SPECIAL EQUIPMENT:** Deionized (Equivalent to Distilled) Water Equipment, Silica Removal Equipment, Boiler Feed Water Heaters, Deaerators, Degasifiers, Chemical Dry Feeders, Chemical Pressure Feeders, Oil Separators (Refining process type)

REPRESENTATIVES IN PRINCIPAL CITIES

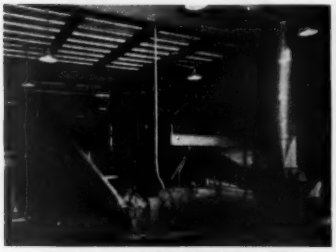
Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES

Bartlett-Snow coal handling at *Bremo*

General View of Bremo Plant
Virginia Electric and Power Co.
Stone and Webster Engineering Corp.
Consulting Engineers

● The illustration above shows both the original building and the new addition of this 60,000 KW plant. All equipment including the track hopper, duplex feeder, 1326′ of belt conveyors, the 70′ dust tight flight distributor in the new addition, and the 111′ distributing belt and belt driven tripper in the original building were detailed and fabricated in our shops and installed by us to Stone and Webster's specifications. For maximum efficiency and fixed unit responsibility, let the Bartlett-Snow coal handling engineers, work with you on your next job.



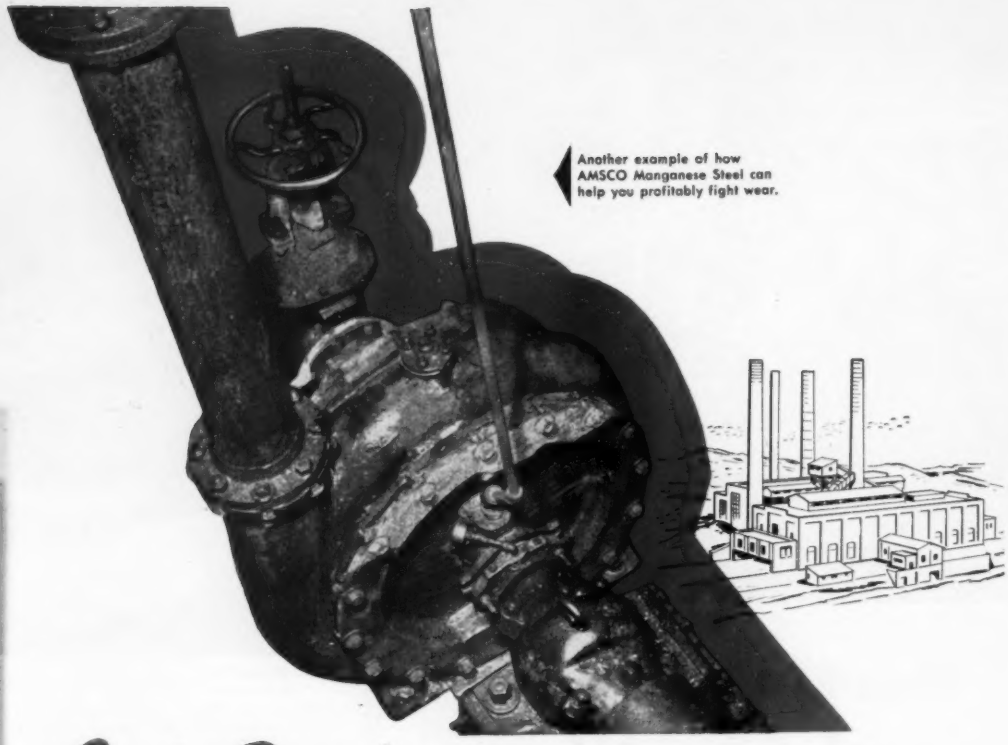
View of Dust Tight Flight Conveyor
Distributing Coal to Bunkers (New Addition)

View of Belt and Belt Driven Tripper
Distributing Coal to Bunkers (Old Building)

DESIGNERS ENGINEERS

BARTLETT-SNOW
CLEVELAND 5, OHIO

FABRICATORS ERECTORS



Another example of how AMSCO Manganese Steel can help you profitably fight wear.

Service Proved by 30 years of operation!

How an AMSCO Materials Handling Pump saved 65% on ash disposal costs

The Central Illinois Electric and Gas Co. at Rockford can speak with authority on the efficiency of AMSCO Materials Handling Pumps. They've been using these tough, wear-resistant pumps for 30 years! The photo above shows one of the first, if not *the* first pump of any make, used for ash disposal. This AMSCO Pump installation was put in service in June, 1921 and it's still in operation.

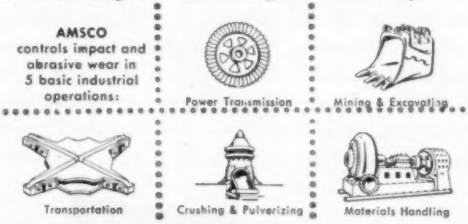
Naturally we're proud of its record. It cut ash disposal costs at this plant from $1.00 per ton way down to 35c per ton—*right from the start.* And, all through these 30 years, as replacements were necessary AMSCO Manganese Steel continued to be the most economical answer to the abrasive wear of ash.

These AMSCO Pumps are designed—and precision made—for a combination of efficiency and rugged service that means real economy. That's why so many hundreds of successful installations have been made since this first one in 1921.

WHEREVER YOU PUMP MATERIALS THAT CAUSE IMPACT AND/OR ABRASION . . .

. . . find out about longer-lasting, dollar-saving AMSCO Pumps. There's a size and type for every type of materials handling service . . . made by the world's largest producers of Manganese Steel castings for all industry.

AMSCO controls impact and abrasive wear in 5 basic industrial operations:



American Brake Shoe Company

AMERICAN MANGANESE STEEL DIVISION

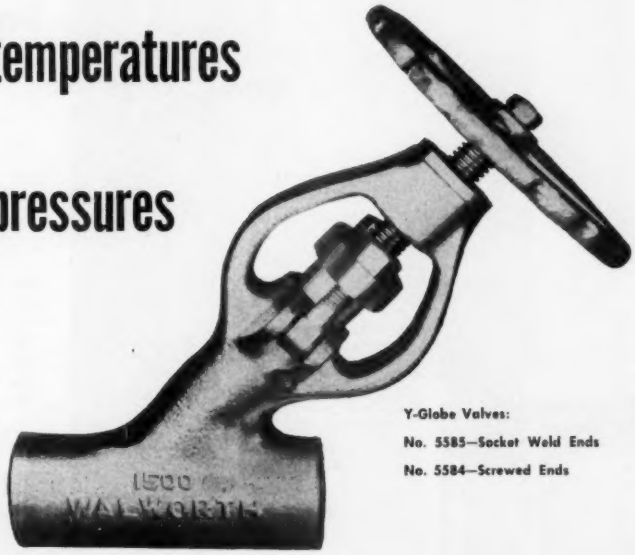
382 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.

Walworth's NEW small cast steel valves

SERIES 1500 – SIZES ¼ to 2 inches

handle { HIGH temperatures / HIGH pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
No. 5587—Socket Weld End
No. 5586—Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE — made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER —designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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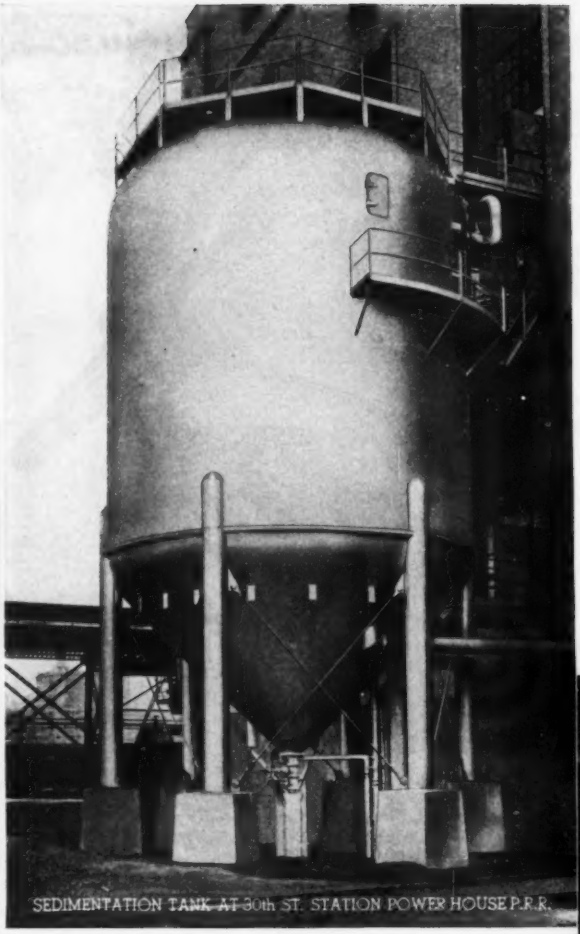


SEDIMENTATION TANK AT 30th ST. STATION POWER HOUSE P.R.R.

COCHRANE

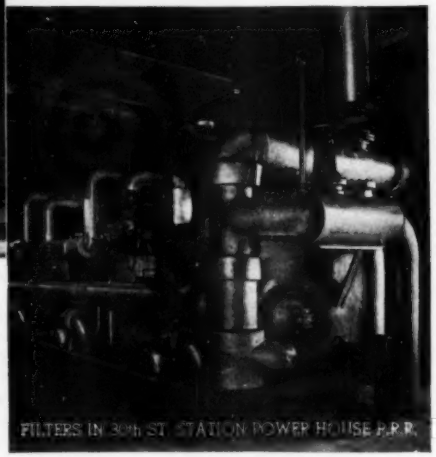
Hot Process SOFTENER

Serves a Great Railroad

ONE of the features of the huge Pennsylvania Station—30th Street, Philadelphia, of the Pennsylvania Railroad is the ultra modern power plant designed by internationally recognized architects and engineers. Recently installed in this power plant to serve additional capacity is a Cochrane two-stage Hot Process Softener for the boiler feed. It will handle 80,000 gallons per hour makeup and 10,000 gallons per hour condensate. The first stage of softening is lime and soda ash, the second stage is phosphate treatment. The water is then filtered.

Cochrane developed the hot process of softening boiler feed many years ago and has continued its leadership in the water treatment field.

Consult Cochrane on any problem involving water conditioning.



FILTERS IN 30th ST. STATION POWER HOUSE P.R.R.

COCHRANE CORPORATION

3106 N. 17th Street

PHILADELPHIA 32 — PENNA.

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CANADIAN GENERAL ELECTRIC CO., LTD. — TORONTO

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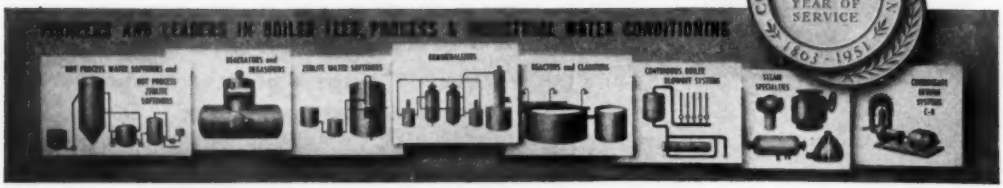
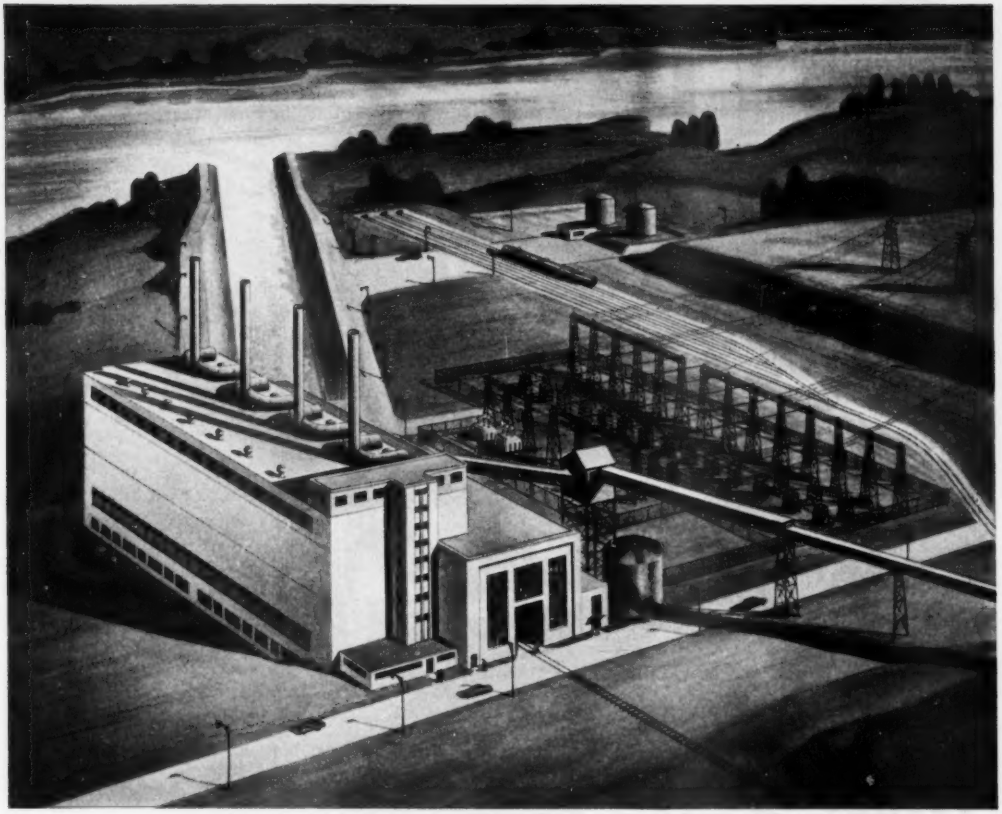
COCHRANE

88th YEAR OF SERVICE 1863 - 1951





POWER FOR MORE THAN A MILLION HOMES

The power produced in this great 200,000 KW steam generating power plant is enough to supply several million people with light and power.

To India where this has taken place, The Kuljian Corporation has sent men, materials, equipment and supplies to construct and operate this power station which was previously engineered and designed at our headquarters in Philadelphia.

Kuljian engineering and construction skill and resources have been applied to a wide range of utility and industrial projects under varying conditions in many parts of the world.

This seasoned experience in Engineering and Construction is also available to you.

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The **Kuljian** *Corporation*

ENGINEERS • CONSTRUCTORS

1200 NORTH BROAD STREET, PHILADELPHIA 21, PA.

Minimum Span, Oversize Casing Studs
Proof against cutting between stages depends on uniform pressure on gasket. On Warren TH Pumps, extra heavy bolting is especially close to channel rings and bolts are spaced and oversized to provide uniform pressure and lock flanges together for maximum strength. (Inner bolts 1¾", outer bolts 1½")

Locked Channel and Case Rings . . .
Inter-stage seals or channel rings are not only wide to reduce by-passing between stages to minimum, but to make it possible to place casing bolts close to rings for maximum and uniform pressure on gasket. Double flange in lower half and single flange in upper half assures secure locking of channel and casing rings.

Genuine Kingsbury Thrust Bearing
Made by Kingsbury Machine Works, not modified type of other make. Oil cooled, heavy duty, duplex ball thrust bearing available and practical for discharge pressures 800 p. s. i. and lower.

Trouble-Free Solid Discharge Nozzle
Discharge nozzle is flared and extra heavy, with studs, instead of the conventional flanged type nozzle, thus eliminating danger of breakage.

Extra Heavy Casing Flanges . . . .
To provide freedom from warping, casing flanges are not only extra heavy but each bolting point is backed up with heavy boss, providing highest possible strength.

"Undercover" Facts—

why WARREN six stage, type TH high pressure boiler feed pumps are a most dependable investment.....

There are many other important factors designed to provide a sound investment over the years. Evaluate the benefits and contact Warren on your next high pressure boiler feed job. Write for Bulletin 244 giving further details.

P-25

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN MASSACHUSETTS

Whether you want one worm-gear speed reducer or a thousand, a standard drive or a unit designed to meet special problems, Cleveland can serve you better.

"Cleveland" is the standard in worm gearing

When you specify "Clevelands—or equal," you can be confident that you are getting the finest in worm-gearing.

The uniform dependability that has distinguished Clevelands through 38 years has established "Cleveland quality" as the measure of value in worms and gears. Cleveland sets the pattern through four outstanding features:

1. *Correctness of design*—proved by years of performance.
2. *Finest of materials*—selected on the basis of long experience and research.
3. *Modern manufacturing facilities*—kept up-to-date by a policy of continuous replacement.
4. *Precision workmanship*—by machinists and other production workers, trained as craftsmen.

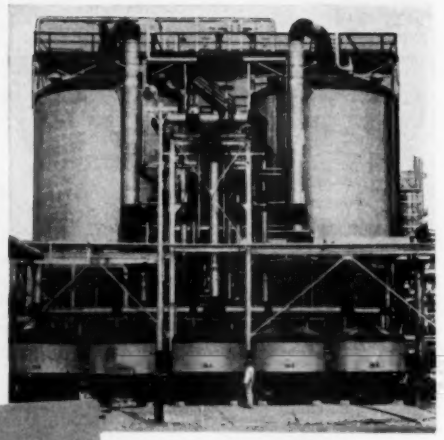
Cleveland offers a complete line of worm gear sets and speed reducers, including the popular fan-cooled Speedaire—to meet the needs of any machinery or equipment builder or user. Representatives in all major industrial centers are at your service. Write for our current catalog.

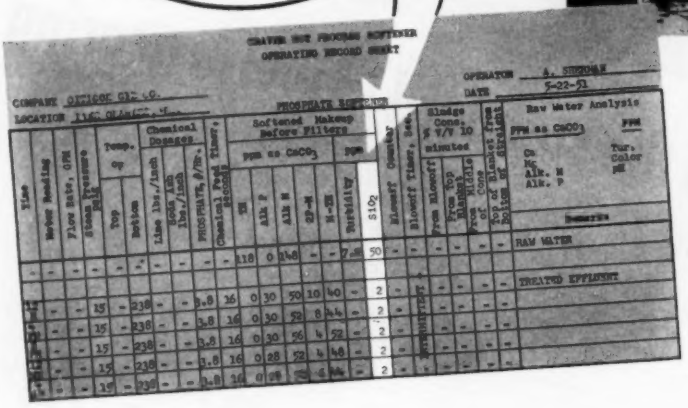
The Cleveland Worm & Gear Company, 3262 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

Silica Reduced from 50 ppm to 2 ppm

FOR 900 psig BOILERS





GRAVER HOT PROCESS SOFTENER
OPERATING RECORD SHEET

COMPANY Illegible
LOCATION Illegible
OPERATION A. SHERMAN
DATE 5-22-51

PHOSPHATE SHEDULE

Time	Meter Reading	Flow Rate, GPM	Steam Pressure PSIG	Temp. °F Top	Temp. °F Bottom	Chemical Dosages Lime lbs./1000 gals.	Soda Ash lbs./1000 gals.	PHOSPHATE, lbs./1000 gals.	Chemical Feed Timer, seconds	Softened Makeup Before Filters ppm as $CaCO_3$ TH	Alk. P	Alk. M	Ca-Mg	M-CH	PPM Turbidity	SiO_2	Sludge Conc. % V/V 10 minutes	Blowoff Timer, Sec.	Blowoff Time	From Top	From Middle	Top of Blanket from Bottom of Cone	Raw Water Analysis PPM as $CaCO_3$ Ca Mg Alk. M Alk. P	PPM Tur. Color pH	Remarks
-	-	-	-	-	-	-	-	-	-	118	0	146	-	-	7	50	-	-	-	-	-	-			RAW WATER
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			TREATED EFFLUENT
[illegible]	-	-	15	-	238	-	-	3.8	16	0	30	39	10	40	-	2	-	-	-	-	-	-			
[illegible]	-	-	15	-	238	-	-	3.8	16	0	30	32	8	44	-	2	-	-	-	-	-	-			
[illegible]	-	-	15	-	238	-	-	3.8	16	0	30	56	4	52	-	2	-	-	-	-	-	-			
[illegible]	-	-	15	-	238	-	-	3.8	16	0	28	52	4	48	-	2	-	-	-	-	-	-			
[illegible]	-	-	15	-	238	-	-	3.8	16	0	28	52	4	44	-	2	-	-	-	-	-	-			

by GRAVER Hot Process Softeners

All hot process softeners aim to reduce silica by using magnesium compounds present in or added to the water being treated.

But here's why the GRAVER Softener does the job so much better than other designs. The first reason is *intimate* contact . . . the water is passed through a deep dense bed of sludge containing the silica-removing magnesium compounds. The second reason is *prolonged* contact . . . the GRAVER design makes the water pass *slowly* through the sludge bed.

The above actual operating record of a GRAVER Hot Process Softener installation shows the effectiveness of the GRAVER design in reducing silica from a high amount down to an amount suitable even for high-pressure boilers, while reducing total hardness from 118 ppm to zero.

No matter what may be *your* particular water softening problem, you can get similarly effective results from a GRAVER installation, because GRAVER manufactures equipment for *every* water conditioning process, with authoritative selection and modern designs based on more than 40 years of specialized experience.

Write for advice on *your* water conditioning problem, and for information on GRAVER designs . . . there's no obligation.

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

216 WEST 14th STREET, NEW YORK 11, N. Y.

GRAVER

GW-410

CONTROL YOUR FEED

BUILD UP YOUR PROFITS . . . THIN OUT YOUR LOSSES

With Jeffrey-Traylor Feeders on the job the flow of coal (or other material) is under absolute control at all times. Photo shows two No. 5 J-T Feeders under track hoppers and feeding to Jeffrey Spiral Conveyor which takes coal to the various bunkers ready for use.

You virtually put your power plant on a strict diet . . . the feeders regulating the amount to be fed, exactly . . . just set 'em and forget 'em. J-T electric-vibrating Feeders are practically foolproof . . . nothing to wear out or lubricate. Power consumption is unusually low.

We build a type and size Feeder (desired capacity) to take care of your feeding requirements properly — tubular or pan decks, single or multiple power units. We also apply electric vibration to Conveyors, Screens, Dryers, Coolers and Packers. To be sure — better buy Jeffrey.

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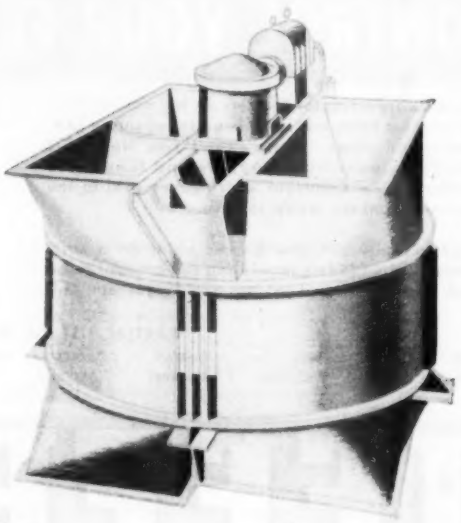
The Ljungstrom Air Preheater Can Help You

1. To improve combustion of low-grade fuels
2. To raise the level of heat recovery
3. To save materials in plant design

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.



If you want to improve the combustion of low-grade fuels . . . raise the level of heat recovery . . . conserve critical materials in plant design . . . you or your consultants can make profitable use of Preheater experience. Let our specialists tell you more about the Ljungstrom Air Preheater, and the outstanding job it has done for hundreds of America's leading industries and public utilities, where the need for preheated air from 300F to approximately 1200F was part of their problem. Our engineers are ready to work with you in applying the Ljungstrom to your own heat recovery problem.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

...Digging for facts

ON AUTOMATIC REGULATING VALVES?

YOU'LL FIND THESE KLIPFEL BULLETINS PRACTICAL, FACTUAL AND USEFUL!

Klipfel engineers have put a lot of experience and research into these bulletins to make them useful to you . . . the man who uses or specifies automatic regulating valves. Each bulletin covers such points as: the advantages and limitations of different valve constructions; selecting the proper type valve for given operating conditions; determining the most effective and economic size valve for the job.

In short, Klipfel engineers have prepared these bulletins to assist you in selecting the type and size valve best suited to your needs.

Write Dept. BC-9 for any bulletins you wish. We'll gladly send them to you.

KLIPFEL REDUCING VALVES
for steam, air and water . . . in lever and weight, air loaded, pilot control and spring loaded types; descriptions, illustrations and complete selection data in Bulletin 148.

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Single and double seated types with direct action or pilot control for remote location. Types shown include quick-acting valves; all are available in angle and globe patterns. Bulletin 349.

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vapor pressure operated valves with spring or weight and lever loading. Valves are ball type, balanced cup and disc or balanced inner valves. Min. temp. 80°. Max. temp. 250°. Range limit of any instrument 40°. Full data in Bulletin 449.

KLIPFEL BACK PRESSURE AND RELIEF VALVES
for control of air, steam and water pressures at the valve inlet in various types for practically any service. Bulletin 648 gives complete details including dimensions and capacities.

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Now Over 3,000 Power Plants

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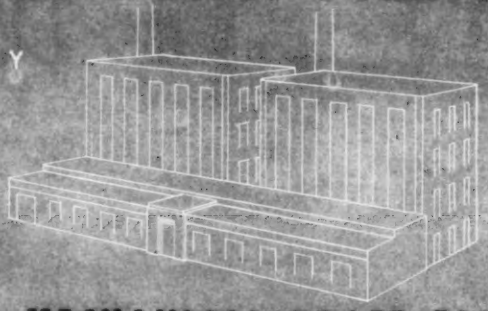

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When it comes to mechanical draft, Clarage **HEAVY-DUTY** equipment has a nationwide reputation for dependable service. Hundreds of Clarage fans—both forced and induced draft fans—have been in **continuous operation** ten, twenty, thirty years **without performance failure** or the need for major repairs. There is no better designed, better built fan equipment available to meet power plant requirements.

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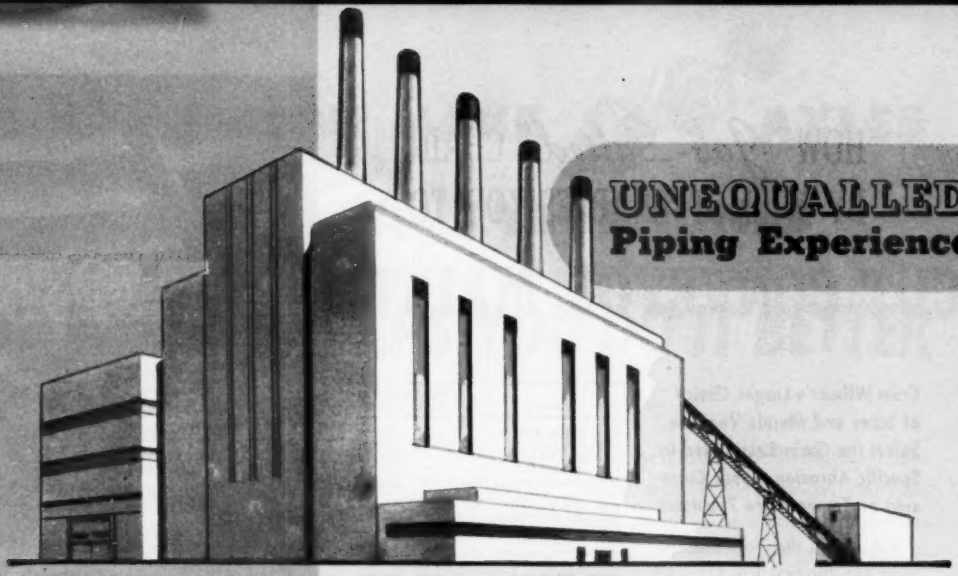

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scattered from Wicasset, Maine to Hawaii
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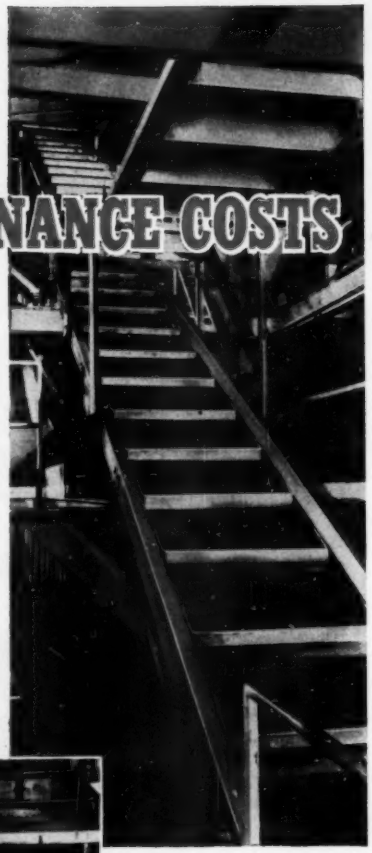
HOW "*Job-Suited*" CHAIN BY WILMOT ENABLES YOU TO

CUT CONVEYOR MAINTENANCE COSTS



From Wilmot's Larger Choice of Sizes and Metals You Can Select the Chain Best Suited to Specific Abrasion, Load, Corrosion or Temperature Problems

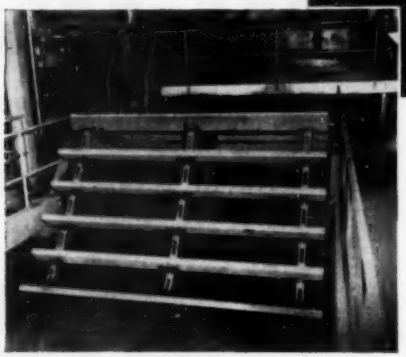
Obviously the chain that will give the longest trouble-free conveying service is the one whose strength and metal specifications most nearly meet the requirements of its particular job. As shown below, Wilmot furnishes chain in the largest choice of metals and sizes. Thus you can better select a "job-suited" chain which will cut maintenance costs.

Standard Keystone Rivetless Chain

Size	Material	App. Pitch	Ave. Ult. Strength
348	EEE-N-DFR	3"	22,000
348	EEE-HT-DFR	3"	29,000
348	3140-HT-DFR	3"	32,000
348	3240-HT-DFR	3"	36,000
458	EEE-N-DFR	4"	38,000
458	EEE-HT-DFR	4"	50,000
458	3140-HT-DFR	4"	52,000
458	3240-HT-DFR	4"	56,000
458	Chrome-Mang., Cast	4"	48,000
468	EEE-N-DFR	4"	55,000
468	EEE-HT-DFR	4"	75,000
468	3140-HT-DFR	4"	89,000
468	3240-HT-DFR	4"	99,000
468	Chrome-Mang., Cast	4"	80,000
678	EEE-N-DFR	6"	73,000
678	EEE-HT-DFR	6"	88,000
678	3140-HT-DFR	6"	97,000
678	3240-HT-DFR	6"	107,000
678	Chrome-Mang., Cast	6"	85,000
688	EEE-N-DFR	6"	110,000
688	EEE-HT-DFR	6"	124,000
688	3140-HT-DFR	6"	135,000
688	3240-HT-DFR	6"	154,000
698	EEE-N-DFR	6"	124,000
698	EEE-HT-DFR	6"	149,000
698	3140-HT-DFR	6"	161,000
698	3240-HT-DFR	6"	182,000
698	Chrome-Mang., Cast	6"	140,000
998	EEE-N-DFR	9"	124,000
998	EEE-HT-DFR	9"	149,000
998	3140-HT-DFR	9"	161,000
998	3240-HT-DFR	9"	182,000
998	Chrome-Mang., Cast	9"	140,000
9118	EEE-N-DFR	9"	200,000
9118	EEE-HT-DFR	9"	240,000
9118	3140-HT-DFR	9"	255,000
9118	3240-HT-DFR	9"	290,000
9118	Chrome-Mang., Cast	9"	230,000
9148	EEE-N-DFR	9"	270,000
9148	EEE-HT-DFR	9"	300,000
9148	3140-HT-DFR	9"	345,000
9148	3240-HT-DFR	9"	375,000
9148	Chrome-Mang., Cast	9"	325,000
105208	EEE-N-DFR	10½"	350,000
105208	EEE-HT-DFR	10½"	395,000
105208	3140-HT-DFR	10½"	450,000
105208	3240-HT-DFR	10½"	495,000
105208	Cast Steel	10½"	460,000

N—Normalized
DFR—Drop Forged
Chrome-Mang.—Chrome-Manganese Steel
HT—Heat-Treated

At right and below, 2 of the 15 Wilmot conveyors recently installed in the ultra-modern Leatherwood, Ky., plant of Blue Diamond Coal Co.



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Full engineering data for designers or maintainers of conveyors and elevators.

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HAZLETON, PA. Plant: White Haven, Pa.

WHETHER YOU MAKE AXLES

OR XYLOPHONES

AIR BY "Buffalo" HELPS YOU DO IT BETTER

NEED humidity control to halt rust? Looking for a cheaper way to convey materials? Want to remove corrosive gases from a continuous process? Striving for a better product and more of it? Better industrial relations? Lower accident rate? All these and many other air jobs are being done throughout industry by "Buffalo" Fans and Air Conditioning Units. "Buffalo" units will work quietly, day and night, in your plant — removing impurities, tempering, ventilating, cooling or heating — providing the atmosphere in which your product and your personnel can be at their best.

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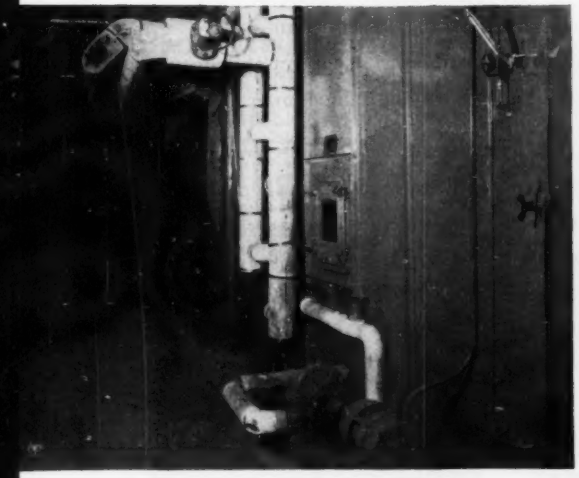
"Buffalo" FANS AND AIR CONDITIONING



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"Buffalo" Air Conditioning Units can create and maintain literally any "climate" your plant requires—efficiently and at a very reasonable operating cost. Above, an air washer removes dust and humidifies a large plant. Many "Buffalo" Air Washers have been continuously on the job for over forty years.

A good, reliable fan like this "Buffalo" Limit-Load model might well provide all the cooling and general air comfort for your plant needs—when other air processing is not called for. Many "Buffalo" Fans have been on the job for forty, fifty and more years. The "Buffalo" line is COMPLETE—to suit any budget, any requirements.

YOUR NEARBY "BUFFALO" ENGINEERING REPRESENTATIVE will give you recommendations — based on your problem and your budget — on turning your plant air to profitable use. He's a Graduate Engineer with 1-5 years of factory training. He's yours to call on, with no obligation.

It's new... so it's MARLEY!

MARLEY
Laminated Fan Cylinder
PATENT APPLIED FOR
THE MARLEY CO., INC.
KANSAS CITY KANSAS

Cooling Tower Fan Cylinders

that are entirely new, distinctive in design . . . are another major addition to Marley's long list of achievements in cooling tower advancement.

Laminated Fan Cylinders are the sturdiest ever applied to cooling towers. Built entirely of overlapping layers of redwood boards, they are structurally strong . . . uniformly strong at every point. No metal shape rings or clamp strips are needed; there is nothing to corrode, loosen or vibrate. Laminated Fan Cylinders are built of the same material as the towers they serve . . . built to last as long.

MODERNIZE ANY LARGE INDUCED DRAFT TOWER

Laminated Fan Cylinders will reduce maintenance time and upkeep expense on any large cooling tower. No painting, no replacing rusted metal parts — you check fan cylinders off the maintenance list when you install modern Laminated Fan Cylinders. Engineers have ordered many of these fan cylinders for replacement since Marley recently made them available.

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PEERLESS PUMPS

FOR FRACTIONAL HP PUMP USERS

HERE ARE THE RATINGS

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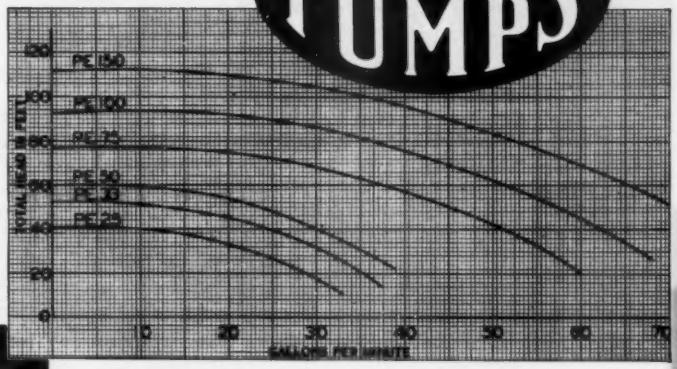
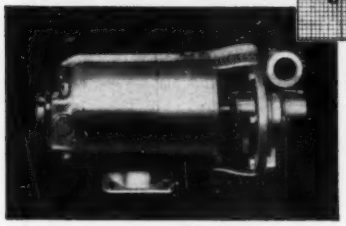
PEERLESS *FLUIDYNE* TYPE PE PUMP ¼ TO 1½ H.P.





KEY TO CHART Performance chart showing head capacity characteristics of Peerless Type PE fractional hp Fluidyne pumps at 3450 rpm

KEY TO PUMP HP
PE 25—¼ hp
PE 33—⅓ hp
PE 50—½ hp
PE 75—¾ hp
PE 100—1 hp
PE 150—1½ hp

GET HIGHEST EFFICIENCY plus

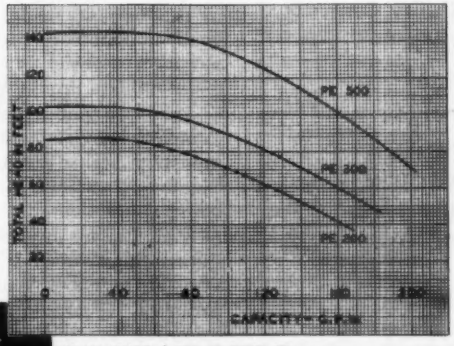
COMPACTNESS • ECONOMY
DURABILITY *AND*
EASY MAINTENANCE

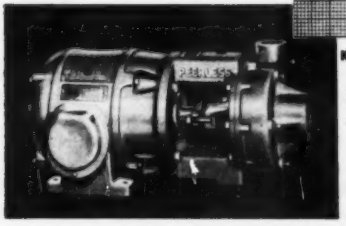
FOR INTEGRAL HP PUMP USERS

HERE ARE THE RATINGS

HERE'S THE PUMP

PEERLESS *FLUIDYNE* TYPE PE PUMP 2 TO 5 HP





KEY TO CHART Performance chart showing head capacity characteristics of Peerless Type PE integral hp Fluidyne pumps at 3450 rpm

KEY TO PUMP HP
PE 200—2 hp
PE 300—3 hp
PE 500—5 hp

Peerless offers in the Fluidyne line of end-suction horizontals, both electric and pulley-driven or flexible coupled models from ¾ hp to 150 hp. Capacity range: up to 5500 gpm; head range: up to 260 ft. New Bulletin B-2300 describes the line completely.

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FOOD MACHINERY AND CHEMICAL CORPORATION
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Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno, Los Angeles; Phoenix; Albuquerque, New Mexico.

PEERLESS PUMPS fmc

Peerless Pump Division
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, Calif.

Please send without obligation new Bulletin B-2300 describing Fluidyne line of fractional and integral hp pumps.

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POW

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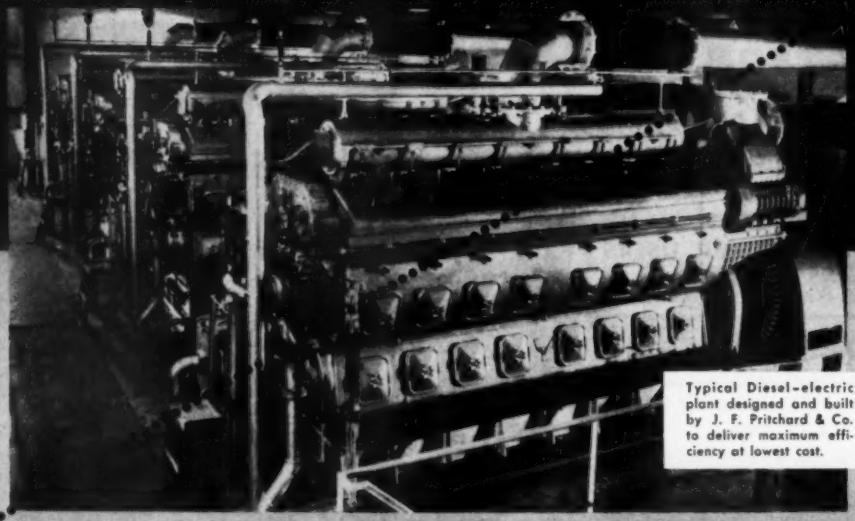

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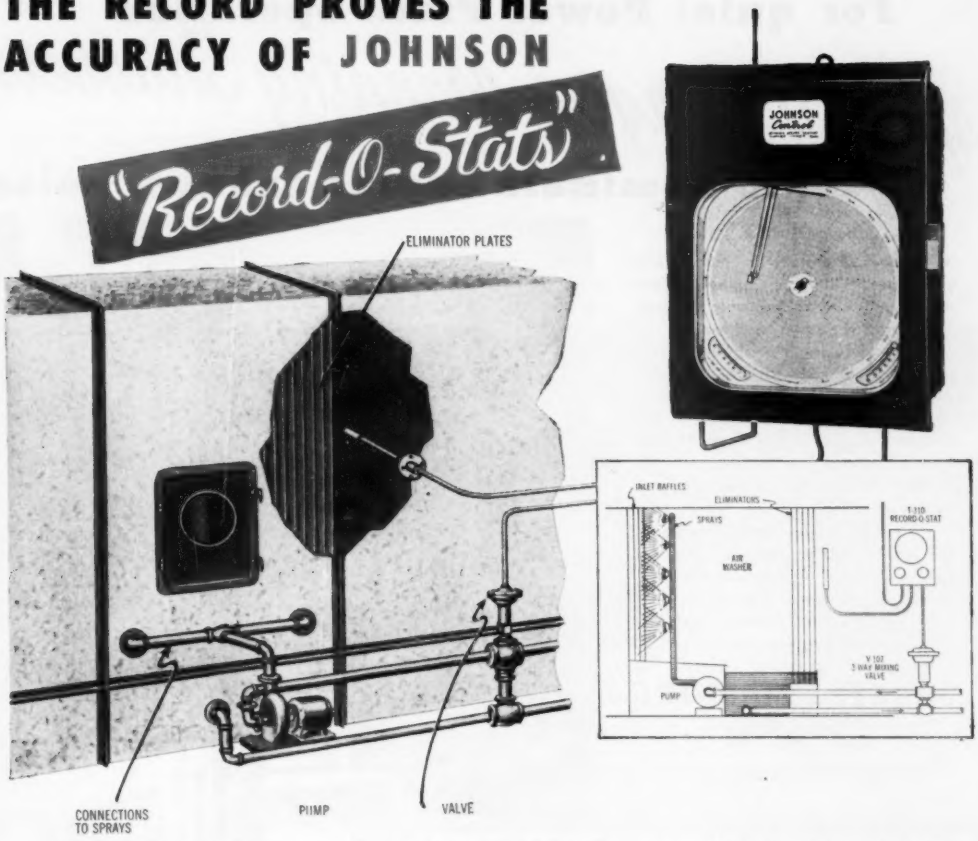
THE RECORD PROVES THE ACCURACY OF JOHNSON

"Record-O-Stats"



The application pictured above shows a Johnson "Record-O-Stat" maintaining a constant dew-point temperature of the air leaving the washer. And, a record of the temperature is always available for reference, which often is an important consideration where industrial processes depend upon space conditions. The Johnson three-way mixing valve, operated by the recorder-controller, insures a uniform temperature of the water which is delivered by the sprays.

Wherever temperatures must be controlled accurately and a record preserved, at the same time, the Johnson "Record-O-Stat" is the finest equipment of its kind. This recorder-controller records the temperatures measured by the bulb on a uniformly graduated chart. Standard charts are available in a variety of temperature ranges and may be had, on special order, in any desired range. On special order, also, the "Record-O-Stat" may be equipped with chart drive and charts to record temperatures for an entire week of operation.

All Johnson equipment is engineered for the most exacting results. When Johnson valves for steam, air and other gasses are halfway open, there's plenty of "throttling range" left for the final 50 per cent of valve stem travel. True modulation over the entire range of valve stem travel!

The exclusive Johnson features make the "Record-O-Stat" widely adaptable and efficient in imparting proportional (gradual) action to the pneumatic valves or damper operators which it controls.

ASK FOR BULLETIN T-310 which describes "automatic" reset and other features obtainable in Johnson "Record-O-Stats". JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

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specify Burgess-Manning Snubbers

to eliminate engine exhaust noise

● Wherever Diesel-electric power plants are located . . . whether engines are large or small . . . reliable Burgess-Manning Snubbers are ideal for effectively reducing the annoying roar of engine exhausts to the noise-level of the surrounding area. By snubbing the exhaust "slugs" through successive snubbing stages, the gas is smoothed to a unidirectional flow. Noise is reduced. No interference with efficient engine operation.

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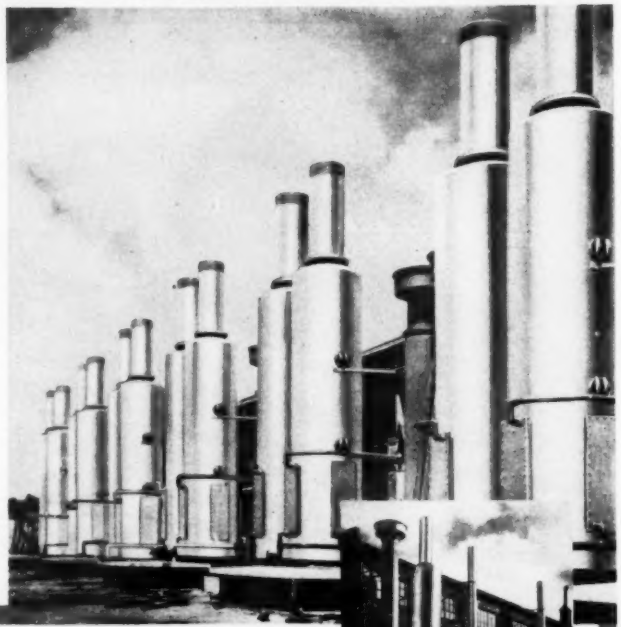
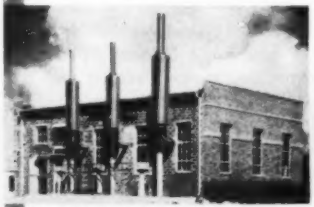
BURGESS-MANNING COMPANY

LIBERTYVILLE, ILLINOIS



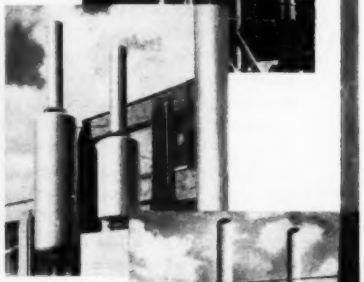
MEXICO — Nordberg Diesels equipped with Snubbers

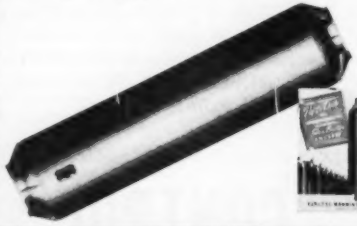
MICHIGAN — Nordberg Diesels equipped with Snubbers



NEBRASKA — Fairbanks-Morse Diesel engines equipped with Snubbers

WISCONSIN — Three Burgess-Manning Snubbers on Worthington Diesels





OHIO — Municipal light plant equipped with Exhaust Snubbers

WRITE FOR BULLETIN

"Bring Your Plant Up to Date With Burgess-Manning Heavy-Duty Slug Buster Snubber."

MICHIGAN — Diesel Electric Power Plant equipped with Snubbers on Fairbanks-Morse engines

Note: behind this arc . . . some 80,000 hours!

. . . when this job-site welder strikes his first arc on your new power piping system, his welding rod has behind it some 80,000 hours of experience . . . specific experience in welding chrome-moly hi-pressure, hi-temperature piping for utility power installations. That's Kellogg's background for the highly specialized power installations of today. Add to this Kellogg's experience in heat treatment and non-destructive testing of thousands of these alloy welds. This total specialized experience is why more and more of the critical piping systems are specified "main steam and reheat piping by M. W. Kellogg".

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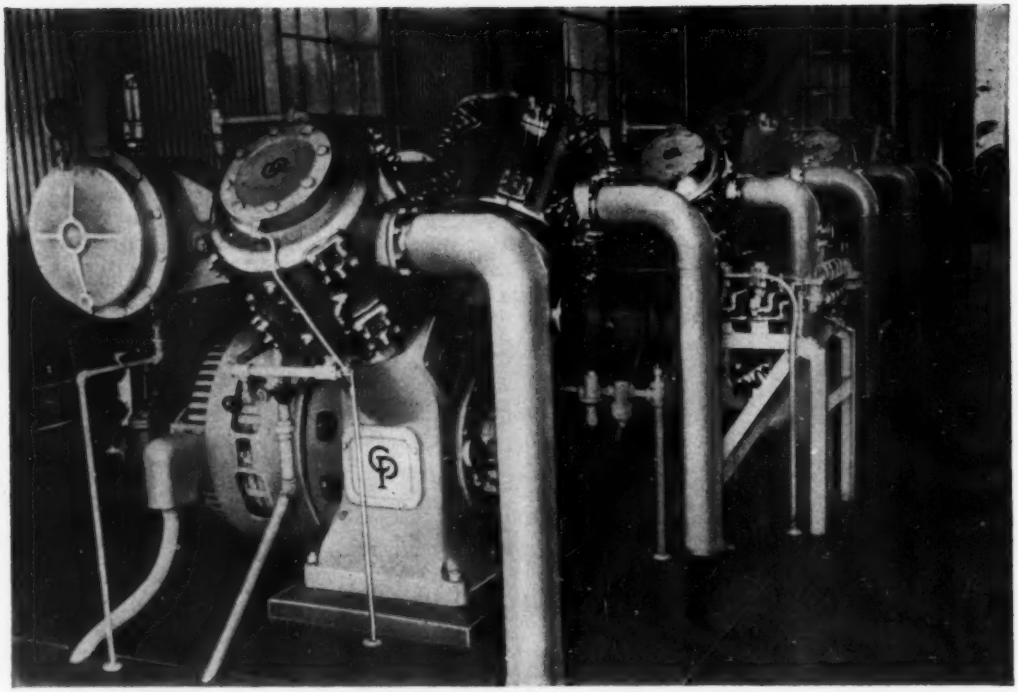

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COMPACT, EASILY INSTALLED TYPE Y COMPRESSOR

Where floor space is limited, and continuous, heavy duty service is required, the Type Y Compressor is ideal. Available with direct-connected, flange-mounted synchronous or squirrel cage motor.

The Type Y Compressor is easy and inexpensive to install, requiring only a simple foundation. No aligning or leveling is necessary.

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Built in sizes from 75 h.p. to 250 h.p., 501 c.f.m. to 1663 c.f.m.; available also with belted and coupled motors.

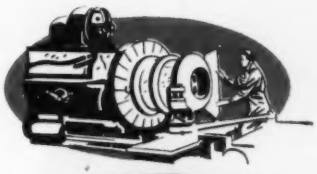
Write for Bulletin 766

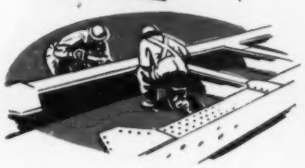
CHICAGO PNEUMATIC TOOL COMPANY

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

"It ain't the individual nor the army as a whole
But the everlastin' teamwork of every bloomin' soul."

Excerpt from "Cooperation"
by J. Mason Knox





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"SINCE 1887"

Heavy Bulk Materials Handling Equipment
All The Way from Design to Erection

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Machining a casting of this size requires special equipment—big equipment for handling big jobs.

Actually, this casting is small compared to the complex piping systems that are planned, prefabricated, and tested *under one roof* at Pittsburgh Piping and Equipment Company.

At P.P.&E. all facilities are integrated . . . engineering, metallurgical and mechanical laboratories, bending, Van Stoning, machining, heat-treating, stress-relieving, testing.

Because our manufacturing personnel and equipment are all under the roof of one great plant—our complete know-how, experience, and facilities are constantly available on every job.

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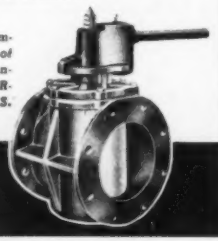

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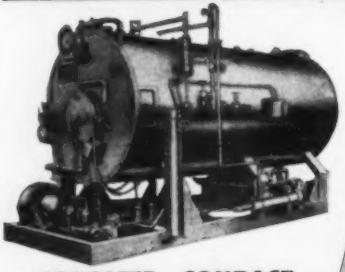

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15 to 200 lbs.

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Manufactured under
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Just "flexing" is not enough . . . it's Directed-Flexing Self-Equalizing—an exclusive Badger Mfg. Co. feature—that makes the real difference in expansion joint performance. The enlarged cross-section above shows the corrugated member in the unique *all-curve* pattern . . . no sharp bends or structure-weakening stresses . . . no danger of premature breakdown.

When combined with the correspondingly shaped Badger Self-Equalizing ring, a progressively controlled movement of each corrugation guarantees a more flexible longer lasting joint—a joint that succeeds where others fail. Get detailed information on the Badger Expansion Joint by writing today. Specify Badger Expansion Joints for every job.

Only Badger Expansion Joints have Directed-Flexing Self-Equalizing rings which progressively control the movement of the all-curve corrugations.

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- Packless . . . pressure-tight single tube—requires no maintenance
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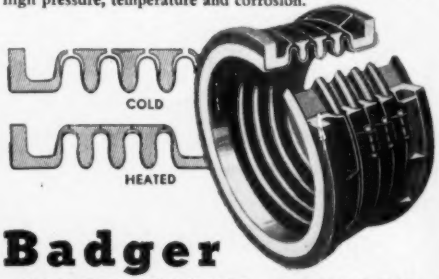
Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel alloys to withstand high pressure, temperature and corrosion.



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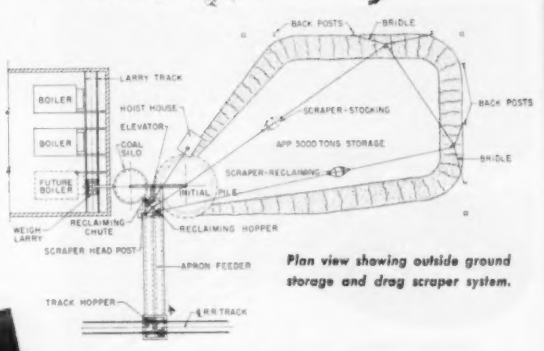
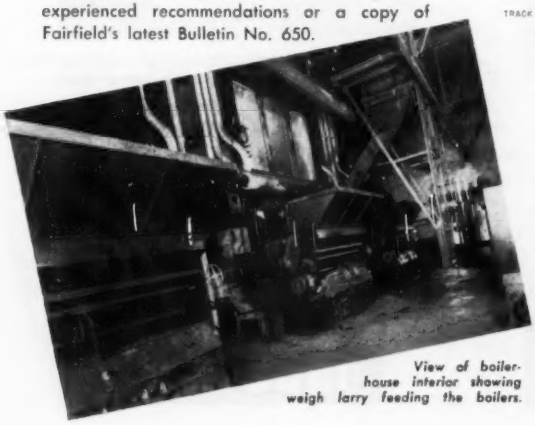
the complete package

When it comes to coal and ash handling equipment, "the complete package" has special meaning to users of Fairfield systems. Take the installation pictured here, for example. This large Michigan manufacturer turned over his boilerhouse problems to Fairfield Engineers—and received in return, a system economically planned to meet his complete requirements—including 3000-ton ground storage facilities. You, too, can enjoy the advantages of Fairfield's "complete package" planning and construction—either for expansion, or new plant facilities. Write or call today for a Fairfield Engineer's experienced recommendations or a copy of Fairfield's latest Bulletin No. 650.



Plan view showing outside ground storage and drag scraper system.



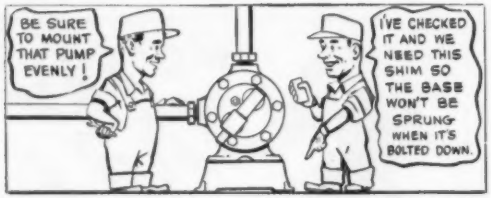
View of boiler-house interior showing weigh larry feeding the boilers.

FAIRFIELD

The FAIRFIELD ENGINEERING COMPANY

335 Chicago Avenue

MARION, OHIO



NO. 1 OF A SERIES

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VIKING PUMPS

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Complete protection for Reducing Valves, Pump Governors, Temperature Regulators, Turbines, Pumps, Traps, Valves and other equipment against dirt, rust and scale is provided at lower cost by LESLIE Self-Cleaning Strainers.

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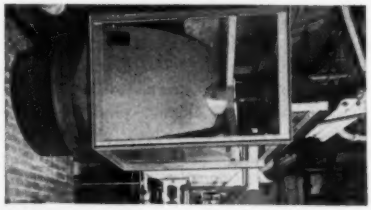

For all boilers from small commercial heating types, up to 100,000 lb./hr. steam generators.

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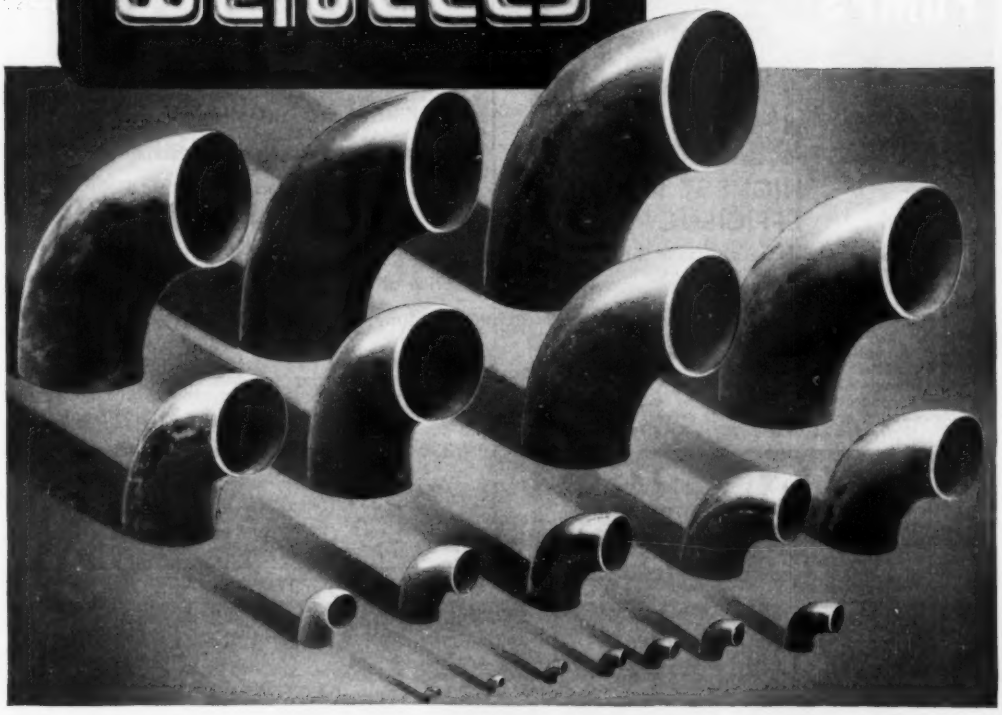

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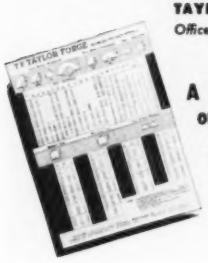

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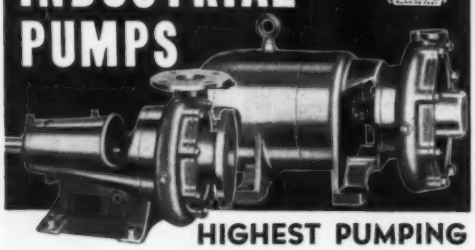
INDUSTRIAL PUMPS



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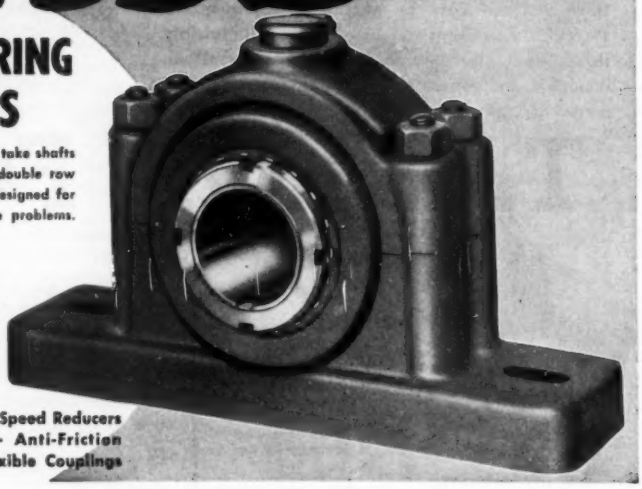

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P-9

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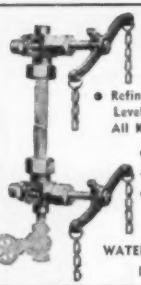

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We sincerely believe this new Taylor-engineered TRANSET Pneumatic Control System combines *the best transmitter, the best controller, and the best recorder* on the market. Find out more about it, and put it to work for you! Write for **BULLETIN 98097,** and ask your Taylor Field Engineer. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

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TRANSAIRE → TO TRI-ACT → TO TRANSET

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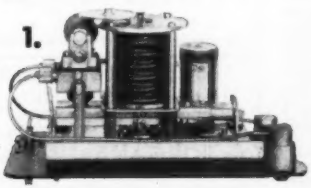

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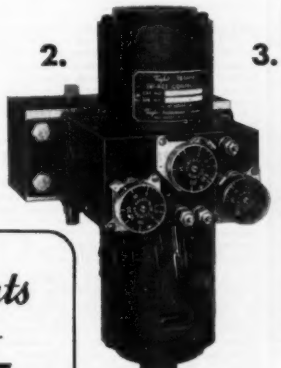

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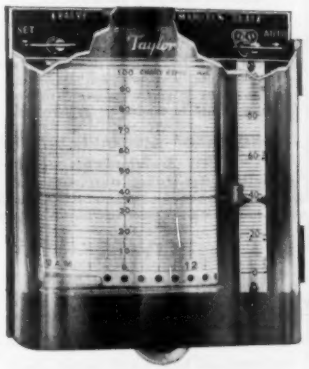

1. TRANSAIRE force-balance temperature or pressure transmitter with SPEED-ACT gives rate action in the measuring circuit. **2. TRI-ACT Controller.** Has high capacity relay air valve for faster response to new control circuit. Wider response adjustments. **3. TRANSET Recorder.** Fits 3⅞" x 4½" opening . . . a "natural" for graphic panels; a great space saver for conventional panels.

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(Continued on the opposite page)

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Wanted. Engineering graduate with experience in water treatment, fuel analysis and general investigations associated with modern electric generating stations and power systems. Must also be able to develop and supervise a central laboratory. Permanent position with a rapidly growing utility in northeastern U.S. Reply giving full details of personal and educational background as well as full résumé of experience, to

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Applicants forward complete experience record and references.

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(Continued from opposite page)

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6 OIL FIRED B & W BOILERS

Heating Surface	11417 Square Feet
Horse Power	1141.7
Design Pressure	200 P.S.I.G.
Working Pressure	200 P.S.I.G.
Capacity—Normal	75,000 lbs./hr.
Steam Temperature	Saturated
Furnace Volume	1024 Cubic Feet
Feed Water Temperature	200°
Tubes	1¼" bent—825
	1¼" str. —1667—12'2" long
	2" straight — 122—12'2" long
	3¼"str. — 16
First 2 rows of Tubes above fire box are	2"
Downcomer & Uptake Tubes	4" & 4½" bent
Oil Burners per Boiler	8
Boiler Dimensions	Width—19'4"
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Water Wall Sides in Furnace	Depth—15'

The above units presently aboard S.S. George Washington. Installed new 1943.

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Boiler, Scotch Marine horizontal type return tube Wet Back, 15' long x 5' diameter with 86 2" diameter tubes 11'-3⅛" long. 200# working pressure, 559 square feet of grate surface. All trimmings: 350# steam gauge, water pump injector water column, safety valve and blow off cock with 3 iron saddles for same. Boiler registered by Nat'l. Board—State Board and Employers Liability Assurance Corp.

Steam Engine, vertical, 2 cylinder compound, 5' wide at base, 8' high, develops 100 H.P., 1500 R.P.M.'s.

Both items used about 20 days.

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2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.

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2—Late 200 KW GE Turbo Generators
2—4900 HP Sync. Motors—257 RPM
1—Rotary Compressor 60000 CF/H 4#
1—IR Compressor 20,000 CF/H @ 100#

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3 Goulds 2" Fig. 3769 centrifugal pumps, 200 GPM at 70 ft. head at 1750 RPM. Bases and couplings for direct motor drive included. (Pumps in storage Jersey City.)

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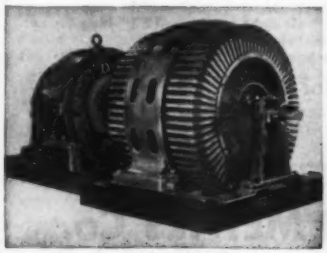
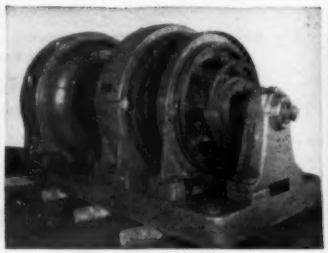
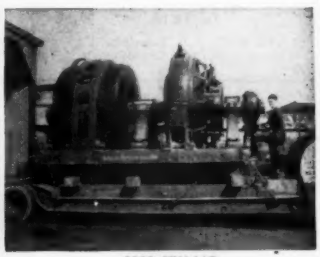


500 KW-MG



750 KW-MG



2000 KW-MG

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
2	2000*	G.E.	600		6600/11000
1	1500	G.E.	720	600	6600/12500
1	1500	Whse.	600	600	2300/4600
1	1500	G.E.	360	275	2300/4400
1	1400	Whse.	360	700	2300
1	1000	Whse.	600	600	2300/4150
1	1000(3U)	G.E.	900	250	2400/4800
1	750	Whse.	900	250	2300
1	500	G.E.	900	600	4150
2	500	Whse.	900	250	6600/13200
1	500	Whse.	1200	125/250	2300
1	800	G.E.	720	125	2300/4000
1	400	G.E.	720	250	440/2300
1	400	Whse.	1200	250	2300
1	400	G.E.	900	275	2300/4150
1	350	G.E.	900	125	2300/4150
1	125	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	Cr. Wh.	1200	550	440
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	900	125/250	2300
1	100	G.E.	1170	125	220
1	100	Delco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
6	70	G.E.	1200	70	220/440

*25 Cycle

ROTARY CONVERTERS

60 Cycles

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1—	2000	G.E.	514	600	13800
1—	1000	Whse.	900	600	11000
1—	750	Whse.	900	600	13200

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/250 ISP 3300/3/60-Exc. & Surface Cond.
1	2500	G.E.	Auto. Ext. Cond. 500 lbs.-800° F.T.T. 175/200 Auto. Ext. 2300/3/60 Exciter & Surface Cond.
2	1000	G.E.	Non-condensing. 175/200 lbs. I.S.P. 5/30 lbs G.B.P., 480/3/60.
2	750	G.E.	Condensing 435#-725°TT ISP-440V-3 ph. 60 cy. New — 1944
1	625	Whse.	Non-condensing. 125/150# ISP 5/20# B.P., 480 v., 3 ph., 60 cy., with exciter
2	500	G.E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60.
1	400	Whse.	Non-condensing 125/150# ISP 5/10# BTU 40/450v. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V. D.C.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240 V. 3 ph. 60 cy.

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—2200	G.E.	MCF	600	360/500
1—1750	West.		600	525/750
1—1500	Whse.		525	600
1— 940	Whse.	QM-R.Brg.	250	140/170
1— 800/1000	Whse.		450	600/720
1— 600	Al. Ch.	MILL	230	400/800
1— 450	Whse.		550	415
1— 300/400	G.E.	DYNA	250	1325/2500
1— 350	Cr. Wh.	CCM-151H	230	1100
1— 325	Whse.	MQ	250	800/900
1— 200/300	G.E.	MPC	230	360/870
1— 250	G.E.	MPC	230	400/500
1— 150	G.E.		600	250/750
10— 150	Cr. Wh.	83H	230	880
1— 150	Cr. Wh.	CMC-65H	230	1150
1— 150	Whse.	SK-201	250	260/950
1— 50/120	G.E.	MCF	230	250/1000
4— 75	G.E.	7LC-50	230	850/2500

FREQUENCY CHANGERS

1—1000	A.C.	25/82½		2300/2300
1—1000	G.E.	25/58	Cycle	4400/2300
1— 500	A.C.	25/60	Cycle	11000/2300V

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed
1	5140	Whse.	4150	600

TRANSFORMERS

60 Cycles

Qu.	KVA	Make	Type	Ph.	Voltages
3	4000	G.E.	HT	3	22000x2300
4	2500	Maloney	OISC	1	69000x13800
3	1250	G.E.	H	1	4800x500
1	500	Whse.	OISC	1	34650x432
1	300	Al. Ch.	Auto	3	4150x2300
4	333	G.E.	HKDD	1	6900/13800x230/460
6	300	G.E.	HT	3	13200x240/480
3	300	G.E.	HT	3	6900x240/480
9	250	G.E.	HT	2	2400x240/480
3	150	Pitts.	OISC	1	480x240/120

RECTIFIERS

1— 750	G.E.	BHW	575	2300
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—4500	G.E.	TS	2300	257
2—2000	Whse.		2300	120
3— 900	Al. Ch.	(New)	2300	150
3— 735	G.E.	ATI	2200/12000	600
1— 650	Whse.	G	2300	133
1— 450	Whse.	Eng.	2300	138.5
2— 350	G.E.	TS	2200	150
1— 300	Whse.		2300	720
1— 300	Whse.	G	440	900
1— 125	G.E.	ATI	440	480
1— 100	Whse.		550	600

SLIP RING

1—1000	Whse.	CW	2300	444
2— 500	G.E.unused	M-574Y	2200	900
1— 500	G.E.	IP	550	585
1— 500	G.E.	IM-MIII	2300	450
1— 500	G.E.	IM	440	900
1— 350	G.E.	MT-442-Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	585
1— 300	G.E.	IM	440	720
1— 300	Al. Chal.	ANY	2200	705
1— 250	Al. Chal.	ANY	440	585
1— 250	G.E.	M-567-TEFC	440	600
1— 250	G.E.	MT-434Y	4000	327
1— 250	G.E.	MT-558S	2200	1750
1— 250	Al. Chal.	ANY	550	600
1— 200	G.E.	MTP	440	1170
1— 150	new Whse.	CW	2200	450
4— 125	G.E.	MT-566Y	440/2200	435
4— 100	G.E.	MT-566Y	440/2200	435
1— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
3— 100	Al. Ch.	ANY	440	695
1— 100	G.E.	MT-556	2300	900

SQUIRREL CAGE

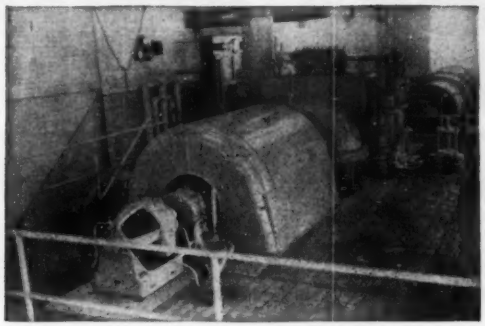
2— 650	G.E.	FT5593Y	440	3570
8— 450	Whse.	CS	2300/4150	854
1— 200	G.E.	IK-17	440	580
1— 200	G.E.	KT-557	440	1800
1— 300	G.E.	KT-574Y	2300	585
1— 200	G.E.	IK-17	440	580
1— 150	Wstghse.	CS8568	440	880
1— 125	Whse.	MS	440	435
1— 125	(New) G.E.	KF-TEFC	440	1190
1— 125	G.E.	KF-TEFC	440	3585
2— 125	Al. Ch.	ARW	2200	1750
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-513	220/440	1750
1— 100	G.E.	KT-556	440	900

RE NU BILT BELYEA MOTORS

BELYEA COMPANY, Inc.

43 HOWELL ST., JERSEY CITY, N. J.
PHONE—JOURNAL SQUARE 2-3334
N. Y. LINE—RECTOR 2-7150

• TURBO GENERATORS •

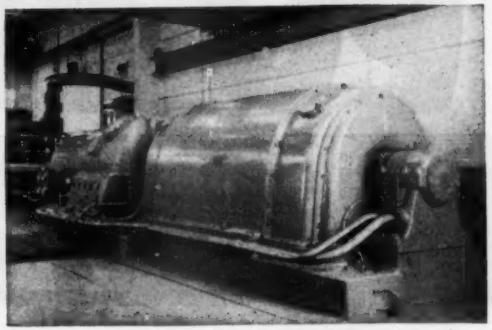


Actual Photo—2500 KW

GENERAL ELECTRIC TURBO UNIT

TURBO: 2500 KW, 3600 r.p.m., Form AA, 11 stage, 800 lbs. ISP, 750° FTT, 200 lbs. G.
AUTOMATIC EXTRACTION, 2½" abs. condensing.
GENERATOR: 2500 KW, 3600 r.p.m., 3125 KVA, 80% p.f., type ATB-2 form T, 3 phase, 60 cycle, 2300 volt.
EXCITER, 25 KW, 125 volt, 3600 r.p.m. direct connected. Complete operating panel.
CONDENSER: Alberger, surface type, 2 pass, complete with circulating, condensate and air removal pumps.
WATER RATES: Calculated at 800 lbs. I.S.P., 750° F.T.T., and 2½" abs.—KW—Lbs. per KW Hr.

3125 KVA	10.89	1875 KW	11.22
2500 KW	10.89	1250 KW	11.92



Actual Photo—6000 KW

ALLIS CHALMERS TURBO UNIT

TURBO: 6000 KW, 3600 r.p.m., 200/225 lbs. I.S.P., 550° F.T.T., 2½" abs., condensing.

GENERATOR: 6000 KW, 3600 r.p.m., 7500 KVA, 80% p.f., 3 phase, 60 cycle, 2300/4100 volts.

EXCITER: 50 KW TURBO UNIT, 125 volt complete operating panel.

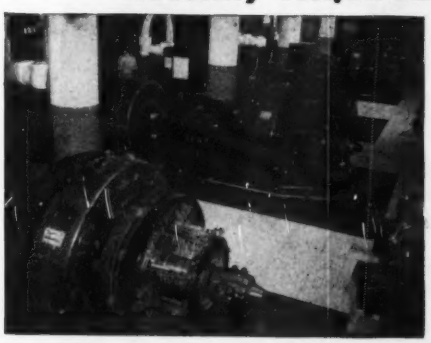
CONDENSER: ALLIS-CHALMERS, Surface type, 2 pass, complete with circulating, condensate and air removal pumps.

This installation may be purchased in its entirety or in parts, and we will be pleased to supply additional information upon inquiry. The 2500 KW G.E. Electric Unit served as a topping installation for the 6000 KW Turbo Unit; and associated equipment included one

• B & W STIRLING BOILER •

100,000 lbs. per. hr., 800 lbs. pressure, 800° F.T.T. complete with pumps, pulverizers, gauges, valves, and standard trim.

Recently Acquired Geared D.C. Turbo Units



2—1000 KW—G.E.—Non-Condensing 200# ISP—100° S.H.—5/20# B.P. 480/3/60.

1—1000 KW—Moore-GE. Condensing Mixed Pressure—200# ISP—100° S.H. 250V. D.C.

2—500 KW—G.E. Non-Condensing 200# ISP—100° S.H. —5/10# B.P.—250V. D.C.

Photo at left shows installation can be inspected as shown.

BELYEA COMPANY, INC.

43 HOWELL STREET JERSEY CITY 6, N. J.

POWER for

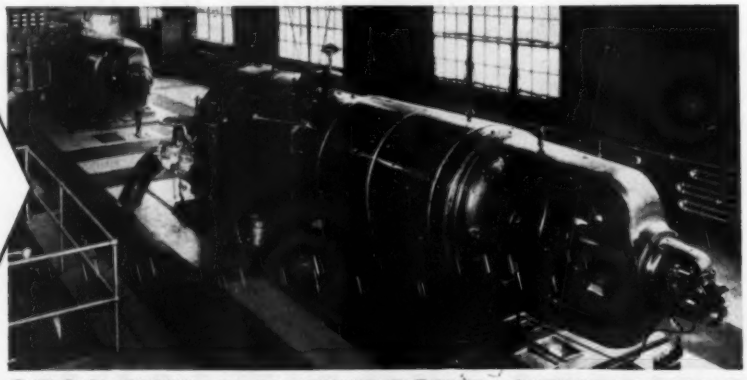
Don't wait 18 months or more for the Power We can give you prompt delivery on Complete

SEND TODAY for BULLETIN 415 Complete Specs.

5000 KW-G.E. TURBINE GENERATOR

General Electric Condensing, 225# psig., 3/60/2300/4160-volt. Very complete Unit. Condition, good. Deliver DUTY FREE in Canada and USA.

SEND TODAY for BULLETIN 900 Complete Specs.



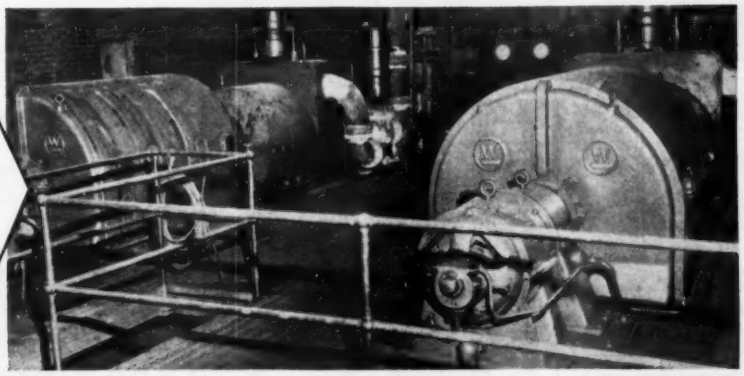
2500 KW-G.E. TURBINE GENERATOR

Two (2) 2500-KW., G.E., Condensing, 160/225-psig., 3/60/2300/4160/6900-volt, 450-F.TT, 3600-RPM., Condition A-1. Two Surface Condensers, 2-pass, 6750-sq. ft., with Auxiliaries. Immediate Delivery.

Production!

Equipment that you need TODAY!
Power Units anywhere in U.S. or Canada

SEND TODAY for BULLETIN 405 Complete Specs.



40/50# BACK PRESSURE TURBINES

One 2000-KW., Westinghouse, non-condensing, available. 250/350-psig., 550°F.TT., 3/60/2400-volt. Condition, like new, limited service. Immediate Delivery.

SPECIAL: 2500-KW., G.E., 850# psig., 825°F.TT., Aut. Extrn., at 150# Condensing. B&W. Boiler, 850# psig., 825°F.TT., complete with pulverized fuel and oil burners. Many other Boilers and Generators 500 to 20,000-KW.

SEND US YOUR SPECIFICATIONS

OUR SPECIALTIES

POWER GENERATING EQUIPMENT

TURBO-GENERATORS BOILERS DIESEL POWER

We have in Stock 25 Complete Sets of Turbine-Generators. Capacities 500-KW to 20,000-KW. All Good Units. Boilers, Diesel Power—A Full Line of Both.

Send Us Your Specifications of Anything Needed

JUST ISSUED: OUR 1951 STOCK LIST: Send for it Today: Is FREE

TELEPHONE. WIRE OR WRITE.

CHARLES WEAVER, M.E.

41st FLOOR PENOBSCOT BLDG.
DETROIT 26, MICHIGAN

TELEPHONES
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-4038

Electrical Equipment—Rebuilt and Guaranteed—Motors—Generators—M-G Sets—Transformers—Controls—

ELECTRICAL EQUIPMENT

REBUILT AND GUARANTEED

PROMPT SHIPMENT — PARTIAL LISTING

—Motors—Generators—M-G Sets—Transformers—Controls—Electrical Equipment—Rebuilt and Guaranteed

800/1600 AMPERE ARC WELDING MOTOR GENERATOR SETS

Each set consists of two generators and one motor, mounted on base. Each Generator: Northwestern Type K29DR, 800 ampere, 80 volts, 1750 RPM. Motor: 125 HP. Allis Chalmers, Type AR, 2250 volts, 3 phase, 60 cycle, 1730 RPM.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5301
2	10	1140	410	West.	HF-7A
2	10	870	220	G.E.	HI-11
2	111	870	550	G.E.	TTC-5008
2	15	1160	440	West.	CW-464C
2	15	870	220	West.	CW-646
1	15	880	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	780	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	878	440	G.E.	MT-334
2	35	600	400	F-M	HV-H16A
2	40	885	2200	ALCh.	ARY-229C
1	40	860	440	G.E.	MT-346
2	50	1150	440	G.E.	M-5356
1	50	880	440	West.	HF-12A
1	50	870	440	G.E.	MT-563
1	50‡	550	220	G.E.	GO-5013***
1	60	686	440	West.	CW-758
1	60	870	550	G.E.	MTC-5546
1	60	845	550	West.	CW-838
1	80‡	845	440	G.E.	MTC-5353
2	125	430	440	G.E.	IL-16
3	150	1750	440	G.E.	MTP-549
1	175	885	550	West.	CW-1002
1	300	495	2300	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
1	300	900	440	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	330	1778	2300	G.E.	IM-18A
3	350	880	2300	G.E.	IM-17A
1	400	868	550	West.	CW
1	600	1770	440	G.E.	IM-21SC
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts. †Intermittent rating. ***3 phase. **New. ‡‡25 cycle. †Also 440 or 550 volts. *Also 440 or 2300 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

Qn	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qn.	HP	Speed	Make	Type
10	2	850	Reliance	Y-23T
23	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
3	7½	850	G.E.	CD-75
10	10‡	1750	Kimble	BA-324
6	10**	1150	Al.Ch.	EHB-80
2	10	850	West.	SK-83
10	13½**	800	West.	SK-93
3	15	1750	G.E.	CD-75
6	15	525	West.	SK-90
1	20	1750	L.A.	ONA-1.851
1	20**	1440	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20**	1450	G.E.	CDM-38
1	20	850	West.	SK-110L
17	25	525	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1750	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	580	G.E.	RC-16
1	150	700	Al.Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	HP	Speed	Make	Type
8	5/7½	600/1800	G.E.	RA-30
1	10	400/1000	Reliance	T-23T &
1	12½	230/360	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RP-11
1	20/25	100/1200	West.	SK-153
1	25	400/1800	G.E.	RP-13
1	25	500/1600	G.E.	RP-12
1	25/29	300/1200	G.E.	RP-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	75	500/1500	Or.Wh.	CCM
1	75	375/750	Or.Wh.	
3	100	225/900	G.E.	MPC-125M
6	100	400/1200	Al.Ch.	
1	100	330/980	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	330/500	West.	SK-220
2	375	350/500	G.E.	MPC

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
2	3	1160	440	L.A.	FS-254
8	5	1730	440	G.E.	K-254
4	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CS-324
2	10	1165	440	West.	CS-326-EXF
1	10	1140	440	Wagner	CP2-326
1	15	1175	440	L.A.	JA-365
1	20	1780	220	G.E.	K-364
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3585	440	G.E.	KF-4058

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-284
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
4	15	1150	440	L.A.	FX-365
1	50	1780	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335

OPEN TYPE MOTORS

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-R3347
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
1	30**	1750	440	Wagner	RPT-384
1	30	1760	220	West.	CS-W364
1	30	1506	220	G.E.	KF-513
2	30	1160	440	West.	CS-464C
2	30	900	220	G.E.	FTR-522
2	30	1800	220	G.E.	KT-513
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-556***
2	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1755	220	G.E.	FT-513
1	30	1180	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RPS-405
1	50	850	220	West.	CCL
3	60*	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
1	75	1160	440	West.	CS-662C
4	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-552
1	100	690	220	West.	C
1	100	580	2300	G.E.	IK-15A
2	100	500	2300	West.	CS-930
1	100	495	2300	Al.Ch.	AN
1	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5668
2	300	587	2300	West.	CS-58A
1	500	1200	140	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts. **New. ***3 Phase. ‡‡Reconnectable for 440 volts.

G. E. DYNAMOMETER

Cradle Type, with control and Dial Scale. (Write for Complete Specifications.)

Qn.	HP	DC Volts	RPM	Type
1	200	250	1200	C

MOTOR GENERATOR SETS

125 and 250 Volts D. C.

(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1725	125	220/440
7.5	West.	1455	125	380/220‡
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
16	West.	1750	125	2300/440
25	G.E.	1200	125	220/440
30	Al.Ch.	1750	125	220/440
50	G.E.	1720	125	220/240†
75	G.E.*	1200	125	220/240

Note: 3KW, 5KW & 7.5KW, 250V Sets Available. **New. *Synch. Motor Driven. 150 Cy. †25 Cy.

Above Items Represent a Partial Listing Only. Your Equipment is Located in Our Cleveland Warehouse. Inquiries Will Receive Our Prompt Attention. All We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVENUE • CLEVELAND 14, OHIO

MOTOR GENERATORS

1—1000 KW G.E. Syn. 250 V. 720 RPM
1—750 KW A-C Syn. 250 V. 720 RPM
2—300 KW G.E. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 500 V. 900 RPM
2—150 KW G.E. Syn. 250 V. 1200 RPM
1—100 KW G.E. Syn. 250 V. 900 RPM

ROTARY CONVERTERS

1—500 KW G.E. Syn. 250 V. 1200 RPM
1—300 KW G.E. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
1—200 KW WEST. Syn. 250 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM
2—100 KW G.E. Syn. 250 V. 1200 RPM

ARMATURES

2—150 KW G.E. Syn. 250 V. 1200 RPM
1—100 KW G.E. Syn. 250 V. 900 RPM

WALLACE E. KIRK COMPANY

502 Grant Bldg., Pittsburgh 19, Pa.

AMERICAN REBUILTS

Famous for Fine Since 1902

NEW PORTABLES WORTHINGTON

315 DIESEL—4 PNEU
105 GAS—4 PNEU
105 GAS—2 PNEU

WE SPECIALIZE IN OIL-LESS COMPRESSORS

RENTAL

273 AIR COMPRESSORS AVAILABLE

RENTAL PURCHASE

GAS — DIESEL — ELECTRIC

AMERICAN AIR COMPRESSOR CORP.

Dell Ave., & 47th North Bergen, N. J.

COMPLETE DIESEL PLANT

3—575 HP F.M. 5 cylinder, 400 RPM. 383 KW F.M. 3/60/2300 alternators. Woodward governors, heat exchangers and complete plant auxiliaries. For sale in whole or part. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. St. Louis 1, Mo.

TURBO GENERATING UNIT

1—100 K.W., G.E. Non-condensing, 3600 RPM. 27,160, 3 ph., 60 cy. 600 volts. (Can be reconnected 480 volts full capacity. Can be reconnect to 240 volts at rating 100 KVA.) Dir. Ctd. exciter.

60 CYCLE MOTORS

1—250 H.P., G.E. slip ring, 3 ph., 60 cy., 2400 volt, 1800 RPM. two bearing self contained, with shaft for coupling.

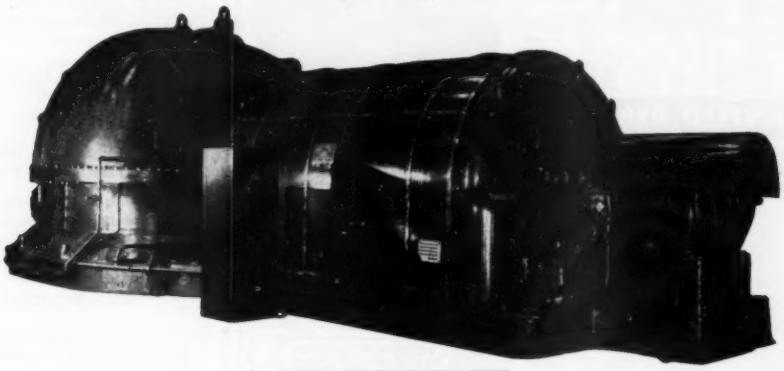
2—50 H.P., G.E., slip ring, Type MT 356, 3 ph., 60 cy., 440 volt, 600 RPM.

ARCHER & BALDWIN, INC.

75 West Street New York 6, N. Y.

Tel: BO. 9-9275-9276

25,000 KVA—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° total temperature complete with direct connected shaft exciter, switchboard and instruments, a 30,000 square foot 2-pass Westinghouse surface condenser, motor driven and turbine driven pumps and condensing accessories.



ACTUAL PHOTOGRAPHIC VIEW

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

Condensing—3 phase, 60 cycle

6250 KVA G.E., 3-stage, 2300/4000 volts, 200# P.S.I., 600° TT.
4000 KVA Allis, 2300 volts, 150-200 PSI.
3750 KVA Allis, 2300 volts, 125-175 PSI.
2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, 2-bearing alternating current generator LESS TURBINE.
2500 KVA G.E. 2400 volts, 200 PSI.
1875 KVA Westghse. 2300 volts, 250 PSI.
1563 KVA Allis, 600 volts, 200 PSI.
1563 KVA G.E., 2300 volts, 225 PSI.
1250 KVA G.E. AUTOMATIC EXTRACTION BLEEDER 2300 volts, 250 PSI.
780 KVA Allis, 480 volts, 150 PSI.
625 KVA G.E. 480 volts, 150 PSI with surface condenser.

Non-condensing—3 phase, 60 cycle

940 KVA Allis 2300/480 volts, 125-150 PSI 12# back.
625 KVA G.E. 480 volts, 125-150 PSI, 10-15# back.
375 KVA Westghse-Moore 480 volts, 250 PSI 5-10# back.
300 KVA Allis-Kerr, 125 PSI.
125 KVA G.E., 2300 volts, 150-200 PSI, 10# back.
125 KVA Westghse. 2400 volts, 150-250 PSI 10# back.

Direct Current

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing.
150 KW (2) Westinghouse, 250 volts, 3-wire, 225-250 PSI condensing.
100 KW (2) G.E., 125 volts, 200-275 PSI.
75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.
60 KW (3) new Westinghouse, 120 volt, 200# P.S.I. condensing.

MOTOR GENERATOR SETS

100 KVA Westghse. 60 cycle, 2400 volts, 900 RPM alternator direct connected 135 HP, 250 volt direct current motor.
62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.
50 KW G.E. 125 volt direct current 1200 RPM to a 3 phase, 60 cycle, 220 volt syn. motor.
10 KW G.E. 125 volts direct current to 12 HP 60 cycle, 220 volt motor.

SEPTEMBER BARGAINS
SPECIALLY PRICED

2—Elliott Company twin-strainers mounted on factory bedplate to a 25 HP, 3 phase 60 cycle, 220/440 volts 1170 RPM General Electric totally enclosed fan cooled motor with miscellaneous piping and valves, practically new.
1—4400 sq. ft. Worthington surface condenser.
2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 390# P.S.I. non cond. G.E. turbine.
1—G.E. Bank of Scott connected 2 to 3 phase, 60 cycle transformers, 2500 KVA capacity.

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Syn. (condenser).
900 HP Allis, 2200 volts, 150 RPM.

UNAFLOW GENERATOR UNITS

Alternating Current—3 phase, 60 cycle

500 KVA G.E., 2400/480/240 volts generator connected Ames Vertical Engine, 150 PSI—5# back.
375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal engine, 125-150 PSI.
175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.
300 KW Burke 250 volt generator connected Skinner, horizontal engine.
250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical non-condensing engine 150#.
250 KW (2) G.E., 3-wire, 250 volts generators connected Skinner engines.
25 KW (2) Allis 250 volt, 500 RPM generators each direct connected American Blower vertical engine.
20 KW Louis Allis 125 volt generator connected Hill vertical Diesel engine MODEL N.
15 KW, 120 volt generator connected Troy Engberg engine 125 PSI.

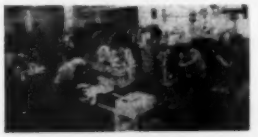
UMC UTILITIES MACHINERY CORP.
1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

here's the reason...

. . . YOU CAN DEPEND ON A-1 PERFORMANCE

GENERAL REBUILDING

Precision equipment in the hands of Chicago Electric "Craftsmen" is the basis for general rebuilding operations on your job. Your motor or other equipment is stripped and given a thorough check and then rebuilt to perform as per original specifications and meet the terms of our guarantee.



GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	Speed
1000	*G.E. (New)	K63478	1800
750	*G.E.	KT	720
550	*G.E.	KF-550	2000
500	*G.E.	PBG	1800
500	*Fr. Morse	H8	1200
450	*G.E.	KF-5078	1200
400	*Cont. (New)	N2	1800
400	*A.C.	ARWW	900
400	*G.E.	IK	514
350	*Cr.-Wh.	6U	3600
300	*Westgh.	CS	3600
300	G.E.	IE-K	1200
300	A.C.	AR	900
300	Westgh.	CS	514
250	West. (New)	CS	1800
250	*L.-Allis	OGX-1468	720
250	Westgh.	CS	600
200	*G.E.	IK-13B	1800
200	*G.E.	IK	514
150	G.E.	KT-546	1800
150	G.E.	IE	1800
150	G.E.	KTP	1200
150	Westgh.	CS950A	600
125	West. (New	CS504	3600
125	*A.C.	AR-226	1800
125	G.E.	K63268 (TEFC)	1200
125	A.C. (New)	AW	1200
125	G.E. (New)	K6333	900
100	A.C. (New)	ARWWT	3600
100	*G.E.	FT542Z	1800
100	G.E.	FTRP	1800
100	*Westgh.	CS	1800
100	A.C. (New)	AW	1200
100	Reliance (New)	AAC (TEFC)	1200
100	U.S. (Vert.)	CFU	1200
100	G.E.	KT3588	720
75	West. (New	CS5058	1800
75	G.E.	KT-346	1200
75	Triumph	TH16	514
75	G.E.	IK	600
75	G.E.	IK	514
60	*Westgh.	CS504	1800
60	G.E.	KT535	1800
60	A.C. (New)	APZ443S (TEFC)	1800
60	A.C. (New)	ARS230	900
60	A.C.	ARS236P	514
50	A.C. (New)	APZ444 (TEFC)	1800
50	West. (New)	CS-445 (TEFC)	1800
50	G.E.	KT527	1800
50	U.S. (Vert.)	SCV927	1800
50	West.	CS640	1800
50	Howell	K-504 (New) (TEFC)	1200
50	G.E.	KT-336	1200
50	Westgh.	CS-504	1200
50	G.E.	KT343	1200
50	*G.E.	KT342	900

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	Speed
1200	*Cr.-Wh.		240
800	*A.C.	2 Brg.	450
650	Westgh.	HE	550
500	*G.E.	IM17B	900
500	Westgh.	CW	350
400	A.C.	2 Brg.	450
400	*G.E.	MT-412	450
300	*G.E.	IM-15	1800
300	*G.E.	MT-410	450
250	*G.E.	MT-422	600
200	G.E.	IM	1800
200	*G.E.	IM-16	600
150	*G.E.	IM-16	900
125	*G.E.	MT-549	1800
125	G.E. (New)	M6333	900
125	G.E. (New)	M6324	720
100	A.C.	ANY	900
100	Westgh.	CW	600
100	G.E.	IM	450
75	*A.C.		900
75	9Bar	OSOO	900
75	G.E.	IM-14	600
60	G.E. (New)	M585	1200
60	Westgh.	CW	900
50	G.E.	IM11A	1800
50	A.C.	ARY	1800
50	Westgh.	CW	1200
50	G.E.	MT346	720
50	G.E.	IM	600
50	G.E.	IM14	425
40	G.E.	MT356	1700
40	Westgh.	CW614	900
40	G.E. (New)	M504U	900
35	Fr. Morse (Vert.)	UAB	1800
35	G.E.	IM	1200
30	G.E.	MT502	900
30	Westgh.	CW445	900
25	G.E.	IM-11	1200
25	A.C.	ARY220	900
20	G.E.	MT512	1200
20	G.E.	IM	720
15	L.Allis(New)	OH326	1800
15	G.E.	IM	1200
15	A.C.	ARY216	900
15	Ideal	AVE	900
10	Westgh.	CW324	1800
10	Westgh.	CW-365	900
10	G.E. (550V.)	IM (25 Cycle)	715

SLIP RING MOTORS

Crane and Hoist Type 30/60/220 or 440 volts

H.P.	Make	Type	Speed
75	Westgh.	CI756A	600
50	GE	ITC-5013	900
50	Westgh.	MW-334	600
25	Westgh.	CI572	900
20	Westgh.	CI	900
15	G.E.	ITC5010-25 Cy.	720
11	Westgh.	CI464	900
6½	B & M	425A (TENV)	1200
5	G.E.	MTC-5730	1800
3	G.E.	MTC5160	1200

AC SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	P.F.	Speed
800	G.E.	T9034	1.0	1800
750	*Westgh.	-	.8	900
700	G.E.	TS		514
320	*A.C.	Dr Pf	1.0	720
300	Cr-Wh.	ENG	1.0	300
300	G.E.	ATI-S	.8	900
250	*A.C.	Dr Pf	.8	720
220	G.E.	ATI	1.0	600
100	El. Machy.	Ped	1.0	450
150	El. Machy.	EM	.8	720
150	*Westgh.	-	1.0	300
125	Parkinson			900
125	*El. Machy.	SYN	1.0	900
125	Cr-Wh.	1038	1.0	900
125	*G.E.	TS	1.0	277
115	El. Machy.	EM	1.0	240
100	Cr.Wh.	1038	.8	900
100	*G.E.	ATB	.8	900
100	Ideal	SMS	1.0	900
75	G.E.	ATI	1.0	900
60	G.E.	T947536	1.0	1200
40	G.E.	ATB	.8	1200
20	Fynn-W.	15VRN		1200
15	Century	ARC365	1.0	1200
4	G.E.	AK 25 Cy.		1500

DIRECT CURRENT MOTORS

230 Volts

H.P.	Make	Type	Speed
1500	Westgh.		300/600
1000	Westgh.		400/800
400	Westgh.		600/1200
375	Westgh.	Ped	650
200	Westgh.	SK210	900
175	Reliance	1400T	675
175	G.E.	ELC11	750
125	G.E.	Marine	1200
100	G.E.	RC34	2500
100	Westgh.	SK173	850
100	A.C.	EI53	575
40	Cr-Wh.	CMC	1750
40	G.E.	CO2004	600
35	Cr-Wh.	CM351	700
25	G.E.	C	600
50	Westgh.	SK120	975
30	Cr-Wh.	CCM	450
30	Westgh.	SK933	1750
30	G.E.	RC 31B	1150
25	Westgh.	SK113	850
25	Westgh.	SK106L	1100

MANY OTHERS—1 HP and UP! ALSO 115 VOLT

D. C. MOTORS—ADJUSTABLE SPEED

230 Volts (*115 Volt)

H.P.	Make	Type	Speed
30	G.E.	C	300/900
30	Westgh.	NA-8	500/1500
20	Westgh.	SK-110L	500/1500
20	A.C.	ER-145	500/1200
15	*Triumph	Planer	225/900
12.5/15	G.E.	RC-116	500/1500
10/15	Reliance	185T	400/1600
10	Elec-D	7½S	300/1200
10	G.E.	BF-11A	300/1200
10	G.E.	BD-10A	600/1800
10	Westgh.	SK-100	400/1600
10	G.E.	CR-10	450/1350

DIESEL-GENERATORS (2)
NEW—31.25 KVA Rogers AC Generators, 3/60/120/208, D.C Exciter driven by direct-connected Cummins Diesel Engine, Model H-I. Complete Control Panel.

HI-PRESSURE PUMPS

GPM	Make	Type	Head
800	Worth.	6D8	925 Ft.
500	Manistee	H	250 Ft.
300	Al.Ch.	NMZ	800 Ft.

ROTARY CONVERTER
1000 KW Westinghouse, 900 RPM, 600 Volt DC; 6 phase, 60 cycle AC, with complete automatic control.

AC SYNCHRONOUS GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

KVA	Make	Type	P.F.	Speed
1500	G.E.	ATI	.8	900
1000	*Westgh.	283D	.8	900
250	*Al-Ch. (New)	-	.8	720
150	El. Machy.	EM	.8	720
112.5	*G.E.	ATB	.8	1200
110	Cr-Wh.	163	.8	900
100	*G.E.	ATB	.8	900
60	Fr. Morse	B	.8	900
55	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200
50	Westgh.		.8	1200
50	Cr-Wh.	5086	.8	1200
37.5	Al-Ch.	EA121	.8	1800

TRANSFORMERS

3—2000 KVA Pittsburgh, 1 Phase 12,000 V to 2300 V

1—750 KVA Westinghouse, AIR—3 Phase 13,800 V to 2300 V

1—750 KVA Westinghouse—AIR—3 Phase 13,800 V. to 2300/4160 V.

3—667 KVA Niagara, 1 Phase 13,000 V. to 480 V.

3—300 KVA General Electric, 3 Phase 12,800 V. to 240/480 V.

3—300 KVA General Electric, 3 Phase, 2400 Y to 240/480 V.

6—167 KVA General Electric, 1 phase 2300/4160Y to 240/480 V.

3—25 KVA *Westinghouse, 1 phase 2400 V. to 240/480 V.

1000 KW MOTOR-GENERATOR SET—3-UNIT
2—500 KW Westgh. DC Gens., 275/187.5 V. 3 wire, 1820 Amps. D/C TO 1429 HP Westgh. Syn. Motor, 900 RPM 11,000 V. 60 Cy., 3 Ph. 3 Brg. on Castiron Factory Base.

MOTOR-GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000	G.E. (3 Unit)	11000	137.5/275
500	Westgh.	2200	250
500	Westgh.	550	250
500	Cr-Wh.	220/440	250
450	G.E.	2300	125/250
400	Westgh.	2300	600
250	West-GE	440	270

First Source for 41 Years for Quality Electrical Equipment

CHICAGO Electric Co.

1320 W. CERMAK ROAD — CHICAGO 8, ILL.

FOR SALE:

1—30 HP 100# W. P. HRT Boiler.

1—39 HP 15# Titusville low pressure Scotch Boiler. Used 1½ years. Like new.

1—61 HP 125# Kewanee Firebox Boiler, used 3 years. Excellent condition.

1—306 HP 125# Titusville High Pressure Scotch Boiler. Used 3 years.

All of the above boilers are available with or without oil burners, stacks, feed pumps and trim, with or without installation in Southeastern U. S.

Also for sale:

1—Nash Duplex Vacuum Pump, rated 40,000 E. D. R. Rebuilt, excellent condition.

2—2,000 gallon hot water storage heaters, with 35 square feet copper coils, condition excellent.

1—New 15,000 gallon vertical oil storage tank (available September).

1—80 HP 125# Cleaver Brooks, used 3 years, condition poor. $650.00.

Call or write us for your steam needs

Industrial Equipment Co.
1620 N. ORANGE AVE.
ORLANDO, FLORIDA

FOR SALE

1—100 HP, 2200 Volt, 3 Phase, 60 Cycle, 600 RPM, Slipring Motor, General Electric, Primary Oil Switch, Drum Control and Grids. Rebuilt by Westinghouse and ready to go.

Regular price $3,916.00
OUR SPECIAL $2,000.00

WHEN YOU CAN'T FIND IT, TRY PORTER

PORTER ELECTRIC CO., INC.
116-118 Third Ave. N., Minneapolis 1, Minn.

FOR SALE

MODERN 1000 KW Turbo-Generator

In Excellent Condition

Non-Condensing, Steel case 80.# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.
6101 Tacony St. Philadelphia 24, Pa.

ELECTRIC MOTORS AND GENERATORS

WAGNER CERTIFIED REBUILT WAGNER

BACKED BY 45 YEARS OF QUALITY AND SERVICE

For QUALITY • SERVICE • PRICE - "Check with WAGNER First!"

OVER 45 YEARS OF EXPERIENCE is back of every machine sold by Arthur Wagner Company. Large stocks and modern facilities insure ample choice and prompt service at reasonable cost. All Wagner "Certified Rebuilt" equipment conforms to standards approved by National Industrial Service Association. Inspect our shop and stock—see why it pays to . . . "Check with Wagner First!"

M-G SETS

KW	Mfr	Input V	Output V
500	Whse.*	2200/440 AC	250 DC
300	Allis Ch.	2200/440 AC	125/250 DC
300	G.E.	440 AC	275 DC
300	Whse.*	2200 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Gen. Elec.*	2300/440 AC	600 DC
150	Whse.*	220/440 AC	125/250 DC
105	Century b.b	220/440 AC	70 DC
100	Allis Ch.* (2)	2200/440 AC	80 DC
100	Whse.	230 DC	220 AC
100	Whse.	220/440 AC	230 DC
100	Gen. Elec.	220/440 AC	125 DC
100	Gen. Elec.	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
65	Whse.	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
50	Gen. Elec.	220/440 AC	250 DC
45	Cr. Wh. b.b.	220/440 AC	125 DC
40	Whse. (2)	220/440 AC	125 DC
40	G.E.	220/440 AC	250 DC
35	Cr. Wh. b.b.	220/440 AC	125 DC
35	G.E.	220/440 AC	45 DC
25	Gen. Elec.	220/440 AC	250 DC
25	G.E. b.b. New	220/440 AC	125 DC

*Syn. motor drive.

D.C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Gen. Elec.	CD189A	230	400/1200
150	Cr. Wh. TEFC	83H	230	800
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	CD125	230	850
75	Whse (2)	SK163	230	850
75	Gen. Elec.	RC	230	1000
75	Northw'n	K20	230	1750
60	Cr. Wh.	50H	230	700
60	Reliance b.b.	651T	230	750
50	Gen. Elec.	LC	115	400/800
50	Cr. Wheeler	CMC	230	1750
50	Gen. Elec.	R.C. 14	250	1050
50	Century New	R91	230	690/1150
40	Gen. Elec.	RC32	550	1200
40	Gen. Elec.	RC-32	230	1150
40	Cr. Wheeler	EH	230	1750
40	Whse.	SK110L	230	1750
40	Whse (2)	SK130	230	850
35/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	SK110L	230	1150
30	Whse. (2)	SK90	230	1700
25	Gen. Elec.	CD83	230	1750
25	Whse.	SK150	230	300/1200
25	G.E. (2)	CD93	230	1150
25	G.E. b.b. New	CDM93	115	1150
25	Gen. Elec.	RF13	230	250/1000
25	Gen. Elec.	CD105	230	800/1500
20	Gen. Elec. (2)	CD83	230	1750
20	Whse. (2)	SK113	230	500/1500
20	Gen. Elec.	RF12	230	400/1600

- **EXPLOSION PROOF MOTORS—**
- **GEARHEAD MOTORS, AC & DC.**
- **FREQUENCY CHANGERS.**
- **CIRCUIT BREAKERS, AC & DC.**
- **SPEED REDUCERS.**

D. C. GENERATORS

KW	Mfr	Type	Volts	Speed
300	Allis Ch. New	MECW	125/250	1200
300	Gen. Elec. 1 brg.	DMC	275	720
150	Cr. Wh. b.b.	83H	250	1150
150	Whse.	SK191	125/250	900
105	Century b.b.	1500 amp	70	1200
100	Gen. Elec.	CD	250	1200
100	Gen. Elec.	C	250	750
75	Gen. Elec.	RC	250	1200
75	Gen. Elec.	RC36	125	1200
65	Whse.	SK160	250	1100
60	Gen. Elec.	LC	250	700
50	Allis Ch. (3)	EW	125/250	1200
50	Gen. Elec.	R.C. 14	250	1200
50	Cr. Wheeler	50H	250	900
45	Cr. Wh. b.b.	FH	125	1750
40	Whse.	SK	250	1200
40	Gen. Elec.	RC32	250	1500
40	Gen. Elec.	RC32	550	1500
25	Gen. Elec.	CD	250	1500
25	G.E. b.b. New	CDM93	125	1450

A. C. GENERATORS — 60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
500	Allis Ch.	3 brg.	240/480	900
500	Gen. Elec.	ATB	240/480	900
300	Gen. Elec.	ATB	600	720
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
156	Elec. Machy.	3 brg.	240/480	514
125	Gen Elec.	ATB	240/480	720
125	Gen Elec.	ATB	240/480	300
90	Gen Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
75	Gen. Elec.	ATI	240/480	1200
56	Gen. Elec.	ATB	240/480	1200
56	Gen. Elec.	ATB	240/480	900
31	Whse. b.b.	late	120/208	1200

A. C. MOTORS — SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	G.E. 3 brg.	I-M	450
1—	400	Gen. Elec.	I-M	514
1—	350	Whse. 2200V.	CW	450
1—	300	G.E. 2300V.	I-M	1800
1—	300	Whse. 2300V.	CW	600
1—	300	Gen. Elec.	I-M	720

1—	250	G.E. 2200V.	IM-17A	600
1—	250	Allis Ch. 2200V.	ANY	514
1—	250	Cr. Wheeler	8R	900
1—	200	Cr. Wheeler	8R	600
1—	200	Gen. Elec.	I-M	360
2—	200	Gen. Elec.	I-M	600
1—	156	G.E. 2300/4600V. Vert.	I-M	1200
1—	150	Gen. Elec.	I-M-17	450
1—	150	G.E.	IM-16	600
1—	125	G.E. New b.b.	M-6325	1200
2—	100	G.E. New	M-6324	1200
2—	100	Gen. Elec.	I-M	1200
1—	100	G.E. Vertical	MT553	1200
1—	100	Cr. Wheeler	8R	900
1—	100	Northwestern	HW	1200
1—	100	Gen. Elec.	MT356	900
3—	75	Gen. Elec.	MT552	900
1—	75	Whse. 2200V.	CW	900
2—	75	Gen. Elec.	MT343	1200
1—	60	G.E. TEFC b.b.	M-6326	720
1—	60	Fair. Morse	BV	720
1—	60	Whse. 2200V.	CW716C	900
1—	60	Gen. Elec.	MT343	1200
1—	50	Allis Ch.	ANY	900
1—	50	Lowell	SR437	1200
1—	50	Gen. Elec. Int.	TTC5613	600
2—	40	Whse.	CW636A	1200
2—	30	G.E. 2200V.	MT332	900
1—	30	Gen. Elec.	MT332	1200
2—	30	Gen. Elec.	MT333	900
2—	25	Gen. Elec.	MT	900
2—	25	Gen. Elec. Int.	MTC5520	720
3—	20	Whse. b.b. New	CW384	1800

A. C. MOTORS — SYNCHRONOUS

HP	Mfr	Type	Volts	Speed
600	Gen. Elec. (2)	TS	2200	514
300	Gen. Elec.	ATI	2300/550	450
300	Whse.	G	2200/440	600
300	Gen. Elec.	ATI	440	720
275	G.E. 25 cycle		220/440	750
220	G.E. 2 brg. .8PF	ATI	220/440	600
250	Gen. Elec.	TS	220/440	900
200	G.E.	TS	220/440	1200
190	El. Machy.	3 brg.	220/440	514
175	Whse.	2 brg.	220/440	900
150	Gen. Elec.	ATI	220/440	720
150	Gen. Elec.	ATI	220/440	900
125	El. Machy. (2)		220/440	1800
120	Burke b.b. .8PF	AC19	2300/440	1200
125	El. Machy.	B.B.	2400/4800	900
100	American b.b.	YGH	220/440	900
90	Gen. Elec.	TS	220/440	1200

A. C. MOTORS — SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr	Type	Speed
3—	500	Fair. Morse 2200V.	HS	1200
1—	300	G.E. 2200V.	KTP581	1800
1—	300	Gen. Elec.	I-K	900
1—	300	Whse. 2200V.	CW	1200
1—	250	Gen. Elec.	FT549AZ	3600
1—	250	Gen. Elec.	IK-17A	450
1—	250	Gen. Elec.	IK-17	600
1—	250	Gen. Elec.	I-K	720
1—	200	Gen. Elec.	IK-17	514
2—	200	Reliance b.b. New	B60858	1800
2—	200	Gen. Elec.	I-K	900
1—	200	G.E. 3 brg.	I-K	600
1—	200	Gen. Elec.	KT566	600
1—	200/112	G.E.	KP559	1200/1800
1—	150	Ideal 2200V.	A-257	1800
1—	150	Gen. Elec. TEFC b.b.	K6233S	1200
1—	150	Gen. Elec. 2200V.	IK-R13A	1800
1—	150	Gen. Elec.	IK-17	450
1—	150	G.E. TEFC	K6326	3600
1—	150	Whse.	CS	720
2—	125	Rel. TEFC New	B60858	1800
2—	125	Gen. Elec.	K-558	900
2—	100	Gen. Elec.	IK-15	600
1—	125	G.E. b.b. New	K6134S	1250
2—	125	G.E. New b.b. HT	KG6324	1200
1—	125	Con. 2200V. b.b.	8C	1800
1—	125	F.M. 2200V. vertical	UH-16D	1200
2—	125	G.E. 2200V. TEFC	K6326	3600
2—	125	Reliance b.b. New	5058	1800
1—	100	Gen. Elec.	KT356	900
1—	100	Gen. Elec.	I-K	1200
1—	100	Gen. Elec.	I-K	720
1—	100	Gen. Elec. b.b. NEW	K5048	1800
2—	100	Whse.	CS	720
1—	100	Rel. TEFC New	5058	3600
1—	100	Rel. TEFC New	5048	3600
1—	75/90	Gen. Elec.	I-K	3600
1—	75	Wagner	22VRM	1200
2—	75	Whse.	CS	720
1—	75	Fair. Morse b.b.	HJQ	600
1—	75	Reliance b.b. NEW	C8084	900
2—	75	Reliance b.b. NEW	C505	1800
2—	75	G.E. TEFC 2200V.	K-8325	900
2—	75	Gen. Elec.	KT543	1200
2—	75	Gen. Elec.	I-K-14	600
1—	75	G.E. Expl. Pr.	K6325	1200
2—	60	Gen. Elec.	KT546	900
2—	60	Howell b.b.	K564	1200
1—	60	Gen. Elec.	KT556	450
1—	60	Reliance b.b. New	CC585	900
2—	60	G.E. Vertical	KT536	1200
1—	60	Gen. Elec.	I-K	900
3—	60	G.E. 2200V.	KT533	1200
2—	60	Reliance b.b. NEW	B594	1800
1—	60	Reliance TEFC NEW	C585	1200
2—	50	Gen. Elec.	KT544	720
2—	50	G.E. Vertical	KT545	720
2—	50	Reliance b.b. New	CC504U	900
2—	50	Whse.	CS	1200
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Howell TEFC	K445	1800
1—	50	Whse. Hollip	WL607	900
1—	50	Fair. Morse b.b.	HJ-13D	900
2—	50	Gen. Elec.	KT527	1200
1—	40	Louis Allis b.b.	OX404	3600
2—	40	Gen. Elec.	KT532	1200
4—	40	Gen. Elec.	KT534	900
2—	40	Gen. Elec.	KT546	900
2—	40	Whse. b.b.	CS-04	1200/900
2—	40	Reliance b.b. New	CB404	1800

A. C. MOTORS — 25 CYCLE

HP	Mfr	Type	Volts	Speed
275	G.E. synch.	ATI	440	750
150	Whse.	HF	440	500
60	Allis Ch.	ARY	440	1500
50	Gen. Elec. Int.	MTC5337	440	750
50	Gen. Elec.	I-K	440	750
30	Gen. Elec.	MT343	440	750
25	Howell	SR	440	750

Arthur Wagner Co.

1435 W. RANDOLPH ST. MOnroe 6-7409 CHICAGO 7, ILLINOIS

QUICK SHIPMENT FROM STOCK—
LOW PRICES — FULL GUARANTEE
Send for Complete Stock Lists

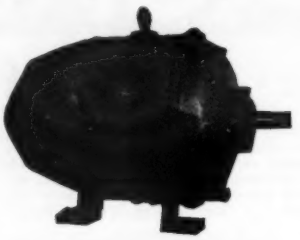
MOTORS - M.G. SETS - CONTROLS

NEW AND GUARANTEED REBUILT

230 V. DIRECT CURRENT

Reconditioned & Guaranteed

HP	RPM	Mfg.	Brgs.
150	250/1000	Rel	SI.
100	450/1000	Whse.	SI.
50	500/1500	G.E.	SI.
50	1150	Whse.	SI.
40	400/1200	Rel (TE)	Ball
35	400/1200	Ideal	SI.
30	250/1000	Whse.	S.SI.
30	500/1500	C-W (TE)	BB
30	500/1500	Rel	Ball
25	250/1000	G.E.	SI.
25	400/1600	Whse.	SI.
25	600/1350	Rel	Ball
25	690	Rel	Ball
20	250/1000	Whse.	SI.
20	300/1200	Rel	Ball
20	500/1500	G.E.	SI.
15	250/1000	G.E.	SI.
15	400/1600	Whse.	SI.
15	400/1200	G.E.	SI.
15	575/1000	Rel	Ball
15	575/1725	L.A.	Ball
15	650/1650	G.E.	SI.
15	700/1350	Rel	Ball
10	300/1200	Whse.	SI.
10	400/1600	Whse	SI.
10	400/1600	Rel	Ball
10	600/1200	Rel (TE)	Ball
10	850	Rel	Ball
10	1750	G.E. (TE)	BB
7½	200/1200	Whse. (TE)	Ball
7½	300/900	G.E.	SI.
7½	400/1600	Rel	SI.
7½	400/1600	Whse.	Ball
7½	450/1200	C-W	SI.
7½	600/1800	Rel (TE)	Ball
7½	1150	G.E.	SI.
3	850/1700	Rel	Ball



NEW DIRECT CURRENT

230 volt-dripproof

Qu.	HP	RPM	Mfg.	Frame
1		690/2660	G.E.	284
10	5	850/1700	G.E.	CD-66
5	7½	575/1725	G.E.	CD-77
1	7½	575/1725	Rel.	46T
1	7½	1750	Rel. (TE)	14T
1	10	575/2300	L.A.	4051
1	30	300/1800	G.E.	CD-1377

CRADLE TYPE DYNAMOMETER

225 HP, Whse, 250 v. DC, 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.

M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2300	Whse.
400	250	2300	Whse.
300	250	2300	Whse.
200	250	2300	Ridgeway
150	250	440	Whse.
100	250	2300	G.E.
75	250	220/440	G.E.
50	250	440	G.E.
30	250	440	Ideal
30	125/250	2300/4000	G.E.
20	250	220/440	G.E.
7½VS	250	220/440	Rel.
3VS	250	220/440	Rel.

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
650	128	2300	Whse.	Engine
400	900	2300	Whse.	80%
350	600	440	Whse.	100%
250	200	440	G.E.	85%
200	900	440	E-M	80%
200	720	440	G.E.	100%
150	600	440	G.E.	100%
100	900	440	G.E.	100%
75	1200	440	G.E.	80%
10	1800	220	Whse.	80%

SLIP RING

HP	RPM	Volts	Mfg.
500	1200	220/440	Elliott (new)
400	900	2300	G.E. (new)
350	450	2300	Whse.
200	450	2300	Burke
50	720	220	Whse.
50	900	220	G.E.
40	900	220	G.E.
7½	1800	220	Rel. (New)

Buy from BOSWICK with confidence

BOSWICK ELECTRIC CO.

WAlbridge 1195

P.O. BOX 55 — AKRON 9, OHIO

TRANSFORMERS

FOR SALE

1 Phase, 60 Cycle

3—400 KVA W-H 13200—600/575/550
3—333 KVA G-E 33000—2300/4000Y
3—250 KVA W-H 13800—2300
3—250 KVA Kuhl 6600—575
3—200 KVA G-E 13200—120/240
3—100 KVA G-E 33000—6900/11950Y
3— 75 KVA G-E 11500—230/460
3— 50 KVA G-E 33000—2400/4160Y
3— 50 KVA A-Ch 33000—2400/4160Y

3-Phase, 60 Cycle

3— 750 KVA W-H 13800—460 Dry Type
1—4000 KVA W-H 15000/12750 Auto

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
CINCINNATI 27, OHIO

MOTORS - M. G. SETS - COMPRESSORS, ETC.

FAST SHIPMENT

MOTOR GENERATOR SETS
3 Ph. 60 Cy.

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
1250	G.E.	720	275	2200
750	Al.-Ch.	720	250	440
400	West.	720	550	2300
300	G.E.	1200	275	2300
300	Ridg.	1200	250	2300
300	West.	1200	550	4000/2300
200	Ridg.	900	250	2300
200	West.	1200	275	2300
200	G.E.	1200	275	2300
200	G.E.	1200	250	4000/2300
150	Ridg.	900	250	2300
100	Ridg.	1200	250	2300/440
75	West.	900	75	440/220
35	G.E.	1800	125	440/220

ROTARY CONVERTERS

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
500	G.E. HCC6	1200	250	4000/2300
300	G.E. HC12	600	250	4000/2300
300	West.	1200	250	4000/2300
300	G.E. HCC6	1200	250	4000/2300
150	G.E. HCC6	1200	250	4000/2300

AIR COMPRESSORS

356 CFM, Chg. Pr. 12"x10"—NSB 100 lbs.
415 CFM, 100±, Allis Rotary direct connected 100 H.P. B.B. Motors.

A.C. MOTORS—3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
1200	G.E.	277	MT—S.R.
400	G.E.	450	MT—S.R.
300	G.E.	450	IM—Sl.Rg.
160	G.E.	600	IK-16—Sq. Cg.
150	West.	514	CS954—Sq. Cg.
150	G.E.	600	ATI—Syn.
100 (2)	Allis	720	ARX—Sq. Cg.
100	West.	900	Syn.
100	West.	1200	CS752C—Sq. Cg.
100	G.E.	1750	KT—Sq. Cag.
100 (2)	G.E.	450	IM16—Sl.Rg.
75	West.	900	CS—Sq. Cg.
75	G.E.	600	ITC5031A
60	West. (2200V.)	600	CW—S.R.
50 (2)	G.E. (2200V.)	1750	KT—Sq. Cg.
50	West.	1750	CS
50 (2)	G.E.	1750	KT—Sq. Cg.
50/12.5	G.E.	900/450	IM 2200 v.
40	G.E.	900	MT—Sl. Rg.
40	West.	900	CS—Sq. Cg.

Also Smaller Units in Stock

TRANSFORMERS—1 Ph. 60 Cy.

KVA	MAKE	PRI.	SEC.
1—3000 (3 Ph)	G.E. Auto	25000	22000
3—500	West.	22000	2200
3— 50	West.	2200	220/110

Also Smaller Units in Stock

MOORHEAD ELECTRICAL MACHINERY COMPANY

361 Noblestown Road — Oakdale, Penna. — Pittsburgh District

BUY From L. J. LAND for

- Dependable Equipment
- Reliable Rebuilding
- 1 YEAR GUARANTEE
- REAL VALUES

3—750 KVA Westinghouse Single Phase Transformers, Primary 13800/6900/4160/2400 volts—Secondary 460 volts. Ready for Immediate Shipment

1 to 50 HP
NEW and REBUILT
TEFC—EX. PR.—Drip proof and Splash proof—Geared Head
IN STOCK

SQUIRREL CAGE MOTORS
3 phase

H.P.	Make	Type	Speed
200	G.E.	KF-6335	580
150	West.	CS	580
100	G.E.	K-544	1175
75	West. (2)	CS-654C	1750
75	Cont. (2)	TEFC	870
75	G.E.	IK	900
75	G.E.	KT-352	865
75	West.	CS	720
60	F-M	TEFC (2)	1750
60	Howell	SCR	1800
60	West. (2)	CS-607	880
60	Rel.	AA	875
60	G.E.	KT-346	865
60	G.E. (2)	TEFC(GH)	427
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	West.	CS	1740
50	West.	XP	1150
50	G.E.	KF-445	1170
50	West.	CS-642C	1160
50	West. (3)	CS	870
50	G.E. (2)	IK	870
50	G.E.	FTR-542	870
50	West.	CS	690

SLIPRING MOTORS
3 Phase

H.P.	Make	Type	Speed
600	Cr.Wh.	131AQ	507
500	G.E. (2)	IM	450
500	Ideal		1150
400	G.E.	IM	870
225	Wagner	25 cy.	710
200	G.E. (2)	IM	1170
150	Wagner	31VRN	900
150	Burke		720
125	Burke		600
75	G.E.	MT	1150
75	West.	CW	720
75	G.E.	MT556	900
75	G.E.	IM	690
60	West.	HF	850
50	Al.Ch.		690
50	G.E.	MT-536	1150
50	West.	CW	1150
50	L.A.	OGH	870
50	F-M	BV	600
50	Al.Ch.	ARY	575
50	G.E.	IM	490

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
475	West.		720
300	G.E.	ATI	900
260	G.E.	TS	900
200	West.	Unused	900
180	G.E.	ATI	900
150	G.E.	TS	720
150	G.E.	ATI	900
135	West.	G	1200
100	Elec.Prods.		1200
55	El.Machry.	BRKT	1200

230 V.D.C. MOTORS

H.P.	Make	Type	Speed
200	West.	SK210	575
150	G.E.	L.C.	1750
100	Al.Ch.		1150
90/45	G.E.	RF-17	950/475
75	Sprague		1000/1500
75	G.E.	RC36	800
75	West. (2)	SK-180	475
75	Cr.Wh.	CMC	375/950
75	E-D	25S	450/1350
75	West.	SK151	250/1000
60	West. (3)	SK-160	680
50	G.E.	RC-12	1750
45/90	G.E.	RF-17	475/1950
50	West. (3)	SK-160	565
50	G.E.	CD	3600
50	G.E.	RF-17	250/1000
50	West.	SK	250/1000
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC-31	1700
40	G.E.	RC-32	1100
40	G.E.	RC-34	750
40	G.E. (2)	CD-1441	400/1800
40	Cr.Wh.	CCM	700
40	Rel.	461T	400/1200
35	West.	SK	250/1000
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West. (2)	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	G.E.	*CDM-77	1750
25	E.D.	10S	1500
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	800
25	G.E.	RF-14	300/1200

115 V.D.C. MOTORS

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CMC	900
50	G.E.	CD	1150
40	G.E.	CD-113	850
30	West.	S	600
25	G.E. (2)	CD	1800
25	West.	SK-103	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
15	E.D.	7½S	650/1230
15	Cr.Wh.	CM	650
10	Al.Ch.		900
10	E.D.	7½S	425/1700

550 V.D.C. MOTORS

H.P.	Make	Type	Speed
765	G.E. (3)	MPC	1045/1350

AC GENERATORS

KW	Make	Type	Speed
180	G.E.	ATB	900
100	G.E.	ATB	360
15	G.E.	ASI	1200

AC GENERATORS
Driven by DC Motors

KVA	Make	D.C. Input	A.C. Output
62½	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	El. Machry.	230	440
18	G.E. (3)	230	120/240
10	Burke	115	120
7½	Hertner	115	440
6¼	G.E.	230	240
5	El. Spec.	115	110
1¼	Al. Ch.	230	110

600 V.D.C. GENERATORS

KW	Make	Speed
400	G.E. (4)	1200
225	G.E.	1200
30	Burke	1750
20	Reliance	1150

GENERATORS
250 V.D.C. Motor Driven

KW	Make	Speed
300	Elliott	1200
250	G.E.	1150
200	G.E.	1200
200	West. Roto-trol	1200
150	West.	900
100	Delco	1200
100	G.E.	700
75	G.E.	1200
40	Rel.	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

125 V.D.C. Motor Driven

KW	Make	Speed
225	G.E. (2)	1200
150	West. (2)	1200
100	West. (2)	900
100	G.E.	1200
100	El. Machry.	1200
50	West. (2)	1150
30	G.E.	1150
30	L.A.	1450
25	El. Machry.	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
125	Hobart (8)	7½
1500	Century	24
2000	G.E.	24V
100	G.E.	30
1000	G.E.	33
150	Watton	40
1000	Chandeysson	40
200	G.E.	42
1500	G.E.	50
1500	Century	60
1500	G.E.	60
1000	G.E.	75

FREQUENCY CHANGERS AND GENERATORS

Size	Make	Output Frequency
150 KW	G.E.	180 cy.
154 KVA	G.E.	180 cy.
15 KW	G.E.	408 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	408 cy.
3 KW	G.E.	408 cy.

ELECTRIC HOISTS

1000# Y & T—D.C.
1000# Thor—Air.
1000# Y & T—A.C. (2)
1000# Shepard—A.C.
2000# R & M—D.C. (3)
2000# C & M—D.C.
4000# Thor—Air
6000# R & M—A.C.

STARTERS—D.C.

1—600 H.P. 230V. West. magnetic.
150—New 230V. D.C. magnetic starters, from 5 H.P. to 75 H.P. C-H, G.E., etc.
40—New 7½ H.P. 230V. magnetic reversing.
1—300 H.P. West. 115V. magnetic.

AIR COMPRESSORS

2—64 cu. ft. Worthington 2 stage Air cooled with 15 H.P. A.C. 880 RPM direct coupled motor, complete.

GUARANTEE YOUR INVESTMENTS!

- LAND gives 1 year guarantee.
- All equipment listed in stock.
- You can see your machines run and tested under power before shipment.
- Complete shop facilities with thoroughly trained & experienced mechanics (many have been with us over 25 years).
- Responsible Organization — 41 years' experience.

Partial List ONLY

EST. 1910 — L. J. LAND INC. — 41st YEAR

156 GRAND STREET — Phone CAnal 6-6976 — NEW YORK 13, N. Y.

There's more than 40% to 60% SAVINGS on SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

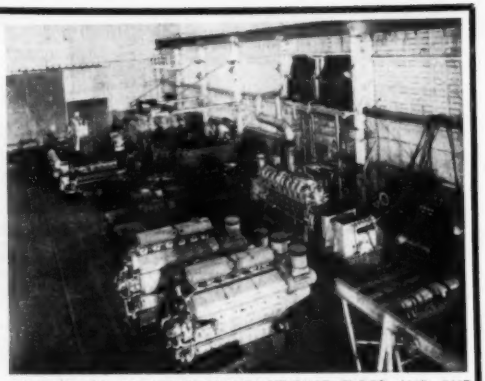
The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A.G. SCHOONMAKER CO., INC.

52 CHURCH ST., NEW YORK 7, N. Y.
PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1500	Fairbanks Morse	33E16	2000	300
1230	Nordberg	F6G168SC	1750	327
1136	Fairbanks Morse	38D	1600	720
1000	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
500	Alco	6-12-1/2x13T	750	600
500	Worthington	EE	750	327
500	General Motors	8-567	720	720
340	Baldwin	VO-6	510	450
320	Buckeye	80	480	600
300	Enterprise	DSG-6	450	450
300	General Motors	8-268A	450	1200
264	Superior	KNA	396	514
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200
50	Caterpillar	D-8800	76	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

Most all units still on foundation. Many may be seen operating

TURBO GENERATOR UNITS

2820 KVA GE 2300 V. Non-Cond.
3750 KVA Wghse. 600 V. Bleeder
1250 KVA GE 480/240 V. Bleeder
937 KVA Wghse. 480/240 V. Bleeder
750 KVA Al. Chal. 480/240 V. Cond.
375 KVA Wghse. 240/480 V. Cond.
375 KVA (2) Al. Chal.—Elliott Non-Cond.
250 KVA GE 600 V. Non-Cond.
187 KVA GE 480/240 V. 370# & 65/165# exhaust
125 KVA GE 240/480 V. Non-Cond.
62 KVA NW. 480/240 V. Non-Cond. 310#
62 KVA NW. 240/480 V.—DeLaval

ENGINE-GENERATOR UNITS

312 KVA GE 480/240 V.—Skinner Unif.
250 KVA (3) EM. 240/480 V.—Skinner Unif.
188 KVA EM. 480/240 V. Ames Unit. 3 Cyl.
187 KVA Wghse. 240/480 V.—Ames. Unif. 3 Cyl.
62 KVA GE 240/480 V.—Ames Unif.

DIESEL UNITS

1000 KVA Elliott-DeLaverne
438 KVA (2) GE-General Motors
375 KVA Fairbanks Morse 32E-14
353 KVA (2) Fairbanks Morse 32-D
250 KVA GE-Buckeye-E
250 KVA Fairbanks Morse 32E-14
200 KVA Fairbanks Morse 32E-14
187 KVA EM.-Buckeye-E
175 KVA Fairbanks Morse 32E-14
160 KVA Wghse.-Buda (Package)
125 KVA GE-Worthington
100 KVA Fairbanks Morse 32E-14
90 KVA (2) Fairbanks Morse 32E-14
75 KVA General Motors (Package)
50 KVA (2) Fairbanks Morse 42F

BOILERS

400 HP (2) Wicks 3 Dr. Low Hd. 160#
316 HP Wicks 2 Dr. Low Hd. 160#
370 HP (2) Wicks Cr. Drm. 300#
360 HP (3) Walsh Widener sec. hdr. 350#
300 HP (2) Keeler CP (Package) 250#
300 HP (3) Union Long Drm. 180#
261 HP Farrar, Firebox 125#
220 HP (2) Vogt 3 dr. Low Hd. 160#
175 HP Keeler Firebox 125#
151 HP (3) Murray, Low Level 250#
150 HP Farrar Firebox 150#
125 HP (2) Erie City Firebox 150#
109 HP Kewanee Firebox 125#
104 HP Lucey Loco. 250#
250 HP (3) Coatesville HRT 150#

Above listed units are only a few of our "SPECIALS." Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

WORLD'S LARGEST INVENTORY

Established 1934 — D & B Rated

ELECTRIC EQUIPMENT CO., ROCHESTER, N.Y.—SEPT. LIST

ELECTRIC EQUIPMENT CO., ROCHESTER, N. Y. — A JULY LIST

WRITE FOR NEW 1951 CATALOG AND SPECIAL APPOINTMENT CALENDAR.

TRANSFORMERS
WORLD'S LARGEST INVENTORY

KVA	PV	SV	KVA	PV	SV
1—1000	2200	220	1— 500	34500	2160
3—1250	13800	600	3— 500	12000	2300
3—1000	66000	7200	2— 500	12000	2500
2— 500	12000	240/480	5— 500	6600	220/440
3—1667	23000	550/2300	3— 500	4800	240/480
3—2500	27600	2300	3— 500	4150	240/480
1—1500	2200	600	9— 500	2400	240/480
5—1000	13200	2300	1— 450	11000	230
2— 750	4150	208/416	1— 450	11000	460
5— 667	33000	2300	3— 333	22000	2300
3— 667	13000	2300	3— 333	11000	2300

PARTIAL LIST — 2000 UNITS IN STOCK FROM ONE TO 250 KVA — ALSO AIR COOLED AND SWITCH GEAR

Write, Wire or Phone LD (long dist.) 65

ELECTRIC EQUIPMENT CO.

P. O. Box 51, Rochester 1, New York

CASH FOR YOUR SURPLUS

60 CYCLE MOTORS
SQUIRREL CAGE MOTORS

HP	SPEED	MAKE
500	720	G. E.
400	1200	West.
400	514	West.
300	600	West.
250	3600	G. E.
250	1200	G. E.
200	600	Al. Ch.
200	1800	Wagner
150	720	G. E.
150	600	G. E.
150	1200	Al. Ch.
150	1800	Al. Ch.

P.S. We stock 3500 new and rebuilt 1 HP to 100 HP

SQUIRREL CAGE AND SLIP RING—25 CYCLE

Quan.	HP	Speed	Make
1	650	365 rpm	S.R.
1	350	750	S.C.
1	300	750	S.C.
1	300	375	S.R.
4	200	600	S.R.
1	200	750	S.C.
1	200	750	S.R.
1	200	500	S.C.
1	200	1500	S.C.

Plus 872 smaller units 1 HP to 150 HP

MOTOR GENERATOR SETS
AC — DC

Quan.	KW	Make	Volts
1	1000	General Electric	250
6	1000	General Electric	600
1	750	Allis-Chalmers	250
2	500	Westinghouse	250
2	500	Westinghouse	1500
1	500	Westinghouse	125
1	400	Westinghouse	125/250
2	300	General Electric	125/250
1	300	General Electric	500
1	250	General Electric	250
1	200	Westinghouse	250
1	200	General Electric	250
2	200	General Electric	125
1	150	General Electric	250
1	150	General Electric	125
3	100	General Electric	125
4	100	General Electric	250
1	100	Allis-Chalmers	125/250

Plus 238 sets from 1 KW to 75 KW in stock.

AC GENERATORS
ALTERNATORS—CONDENSERS

Quan.	KVA-HP	RPM	CYCLE
1	2500	720	60
1	2500	900	60
1	1675	600	40
2	1500	900	60
1	1430	514	60
1	1250	1200	60
1	1000	750	25
1	800	900	60
3	750	900	60
2	650	139	60
1	500	720	60
1	500	750	25
1	400	450	60
3	400	1800	60
1	350	750	25
1	350	720	60
1	350	225	60
1	333	1800	960
1	320	1200	120
1	300	750	25
1	300	180	60
1	250	720	60

Plus 78 smaller units from 3 KVA to 200 KVA

DC MOTORS
ADJUSTABLE SPEED—230 VOLT

Quan.	HP	Make	Volts
1	300	General Electric	400/800
1	250	West.	250/675
4	40/250	West.	540/3000
1	150	West.	300/900
1	100	Reliance	500/1500
1	100	G. E.	400/1000
1	100	West.	450/1350
1	100	G. E.	1050/4000
1	90	F. M.	600/1500
1	75	G. E.	400/1200
1	60	G. E.	220/1000
1	60	G. E.	300/1200
1	50	G. E.	250/1000
1	50	G. E.	400/1200
1	40	G. E.	250/1000
1	40	Cr. Wh.	400/1600
1	35	West.	250/1000
1	35	G. E.	500/1000
1	30	Reliance	400/1200
1	30	Cr. Wh.	500/1500
1	25	Reliance	400/1600

Plus 327 smaller units 1 HP to 20 HP

SLIP RING MOTORS

Quan.	HP	Speed	Make
1	600	1800	G. E.
1	500	1800	G. E.
1	500	514	Al. Ch.
4	500	900	G. E.
1	350	720	G. E.
1	300	450	G. E.
1	300	514	G. E.
1	300	900	G. E.
1	300	720	G. E.
1	200	600	G. E.
1	200	1200	G. E.
2	150	720	G. E.
1	125	1200	Al. Ch.
1	100	900	Wagner
4	100	450	G. E.
8	75	720	West.

Plus 937 smaller units 1 HP to 40 HP

ROTARY CONVERTORS

Quan.	KW	Make	Speed	Volts
5	500	General Electric	1200	250
7	400	Westinghouse	1200	250
1	100	General Electric	1200	250

P.S.—We Stock Explosion-Proof Motors—Class 1-D & 2-G

Note: We Stock 6000 New Motors, Controls, Frequency Changers

SEND US YOUR INQUIRIES!

CONSTANT SPEED 230 VOLT

HP OR KW	MAKE	Speed
400 HP	Elec. Dyn.	1500
300 KW	G. E. (170 V)	1200
300 HP	Cr. Wh.	1200
250 KW	Al. Ch.	720
150 KW	West.	720
125 HP	Star	1200
100 HP	G. E.	900
75 HP	G. E.	1200
75 KW	G. E. 325 V	1200
50 HP	West.	1200
50 HP	Burke	1800

Plus 675 smaller units 1 HP to 40 HP also 115 V & 550 V, DC.

ELECTRIC EQUIPMENT COMPANY

PHONE LD 65

New and Rebuilt **ROCHESTER, N. Y.** *1 H. P. to 2500 H. P.*

MOTORS · MG SETS · TRANSFORMERS · CONTROLS · COMPRESSORS

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—15630 KVA G.E. Cond. 60 cy. 13200 V. 275-lb.
1—12500 KVA Allis Cond. 60 cy. 13800 V. 300-lb.
1—10000 KVA G.E. Cond. 25 cy. 6600 V. 200-lb.
1— 6250 KVA Allis Cond 60 cy. 4000 V. 175-200-lb.
1— 5000 KVA West. Extr. Cond. 60 cy. 480 V. 365-lb.
1— 3750 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200-lb. 40-lb. BP
1— 2500 KVA G.E. Extr. Cond. 60 cy. 480 V. 125-200-lb. steel valve chest.
2— 2250 KVA G.E. Cond. 60 cy. 240-400-lb.
1— 1875 KVA West. Cond. 60 cy. 2300 V. 170-lb.
1— 1875 KVA G.E. Cond. 2300 V. 60 cy. 180-lb.
1— 1563 KVA G.E. Cond. Extr. 60 cy. 2300 V. 200-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200-lb.
1— 938 KVA G.E. Extr. Cond. 60 cy. 240 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA G.E. Non-C. 60 cy. 2300 V. 150-lb. 35-lb. BP
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. BP

DIESEL ENGINE UNITS

1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1—1000 HP Superior 2300 V. 60 cy.
1— 900 HP Amer. Loco. 250 V. DC
2— 650 HP Amer. Loco. 440 V. 60 cy.
1— 250 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS

1—375 KVA Skinner Uniflow 480 V.
1—312 KVA Skinner Uniflow 480 V.
1—250 KVA Ames Vertical Uniflow 480 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—150 KVA Ames Vertical Uniflow 240 V.

ROTARIES—60 CY.

QU.	KW	MFR.	VOLTS-DC	TRANS.	RPM
1	3250	G.E.	225/285	13800	300
3	1000	G.E.	600	13200	900 Auto.

SPECIAL

1—150 HP General Electric synchronous cubicle motor starter, type CR-7811, across-the-line, reversing dynamic breaking.

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	2500	G.E.	2400/4160	720
1	2000	West.	2300	720
1	1500	G.E.	4600	900
1	1500	West.	2300	900

MERCURY ARC RECTIFIERS

QU.	KW	KIND	DC VOLTS	TRANS.
2	4500	Multi Anode	600	13800
4	3250	Ignitron	650	13800
2	1850	Ignitron	560	13000

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	VOLTS-D.C.	A.C.	RPM
2	1500	G.E.	600	13200	720
1	1000	G.E.	600	13200	514
1	500	West.	125	2300	720
1	400	G.E.	250	4600	720
1	75	West.	125	440	1200

SYNCHRONOUS MOTORS—60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
2	1750	G.E.	2200	3600
2	700	West.	2300	200
1	600	G.E.	440	360
2	350	G.E.	2300	257
1	300	G.E.	2300	900
1	300	West.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	3125	G.E.	25/60	300
1	3000	G.E.	60/25	300
2	2500	G.E.	25/62½	750
1	2450	G.E.	62½/25	750
1	1500	G.E.	25/62½	750
1	1250	G.E.	25/60	300
1	1250	West.	25/60	300
1	500	A.C.	25/60	300

TRANSFORMERS—60 CY.

1— 7500 KVA G.E. 138000—41800, 3 ph.
3— 3333 KVA West. 132000—7620/13200 Y
3— 1000 KVA West. 66000—7200
3— 500 KVA G.E. 66000—2400
1— 2500 KVA G.E. 59/73 KV—5 taps, 3 ph.
3— 200 KVA Mol. 44000/22000—440/220
3— 75 KVA G.E. 44000—2300/4600
3— 8333 KVA West. 41800—13800
3— 100 KVA Wag. 36000—7200/12470 Y
1—18750 KVA A.B.B. 34840—11000, 3 ph.
1— 7500 KVA Al. Ch. 33000—13800, 3 ph.
3— 200 KVA Wag. 33000—7200/12470 Y
3— 200 KVA West 33000—2400
3— 167 KVA G.E. 33000—2300/4000 Y
6— 150 KVA G.E. 34500—2300/4600
4— 150 KVA G.E. 33000—7200/12470
6— 75 KVA Mol. 33000/16500—2300/6900
3— 75 KVA Wag. 33000—7200/12470 Y
9— 50 KVA G.E. 33000—2300
4— 450 KVA Al. Ch. 25410/44000—13280/23000
1— 1000 KVA G.E. 22000/11000—2300, 3 ph.
4— 750 KVA Wag. 19050/33000 Y—6900/11950
2— 200 KVA G.E. 11500—220/110
3— 200 KVA Mol. 11000—2300
3— 37½ KVA Pitts. 4800—230/460
3— 150 KVA G.E. 2400—240/480
3— 100 KVA Kuhl. 550—20/110
4— 15 KVA Stand. 450/225—117

OIL CIRCUIT BREAKERS

4—600 A. 154 KV G.E. FHKO-39-2500 Outdoor
1—600 A. 132 KV G.E. FHKO-60-1500 Outdoor
2—600 A. 73 KV G.E. FHKO-139-1000 Outdoor
1—400 A. 73 KV G.E. FHKO-236-500 Outdoor
1—600 A. 37 KV G.E. FHKO-139-450 Outdoor
1—400 A. 37 KV G.E. FHKO-236-500 Outdoor
1—400 A. 37 KV Condit FO-40-B-750 Outdoor
4—600 A. 15 KV G.E. FHKO-139-750 Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street — New York City 7, — WOrth 4-1470

IN STOCK FOR IMMEDIATE SHIPMENT

NEW and REBUILT MOTORS

3 PHASE, 60 CYCLE, 220 or 440 VOLTS UNLESS OTHERWISE NOTED

HP	MFG.	RPM	TYPE
1000	GE	1200	IM-2300 v*
700	West	300	CW-2300 v*
600†	GE	750	IM-2300 v*
400	Cent	1200	NZ 806
300	GE	600	IM-2300 v*
200	GE	600	KT-2300 v*
200	GE	1200	IM-220 v*
150	GE	514	KT 506
150	GE	3600	TEFC
125	West	180	HR-2200 v**
125	GE	650	KT
125†	GE	750	IK-15, 2200v
100†	GE	750	IM-2300 v*
100	Ideal	1200	PBR**
100	GE	1200	TEFC‡
75	Ridge.	720	*
75	GE	1800	TEFC
60	GE	1200	MT 546*
60	West	1800	445, BB
60	GE	1800	32000 TEFC
50	West	900	CS 646 C
50	A-C	900	ARZT,TEFC
50	GE	15	KG 504 (4)‡
50	GE	1200	KG 445 (2)‡
50	GE	1800	TEFC
50	West	3600	CS 405
40	A-C	720	505, TEFC
40	GE	900	KG 445 (2)‡
40	GE	900	KT 242
40	A-C	900	TEFC
40	GE	1200	KT
40	GE	1200	TEFC-XP
40	GE	1800	CS
30	West	1200	CS 567 C
30	GE	1200	445, XP
30	GE	1800	K 365
30	West	1800	CS 405
25	GE	1200	FT 532
25	West	1200	CS 556 C
25	GE	1800	FT 509
20	West	1800	CS 364
20	GE	900	MT 532*
20	Delco	1200	TEFC
15	GE	720	KT
15†	GE	750	K 405
15	GE	1200	KT 502
15	GE	900	K 365
15	Baldor	1200	TEFC
15†	GE	1500	KT 313
15	GE	1800	K 324
15	GE	3600	KF 324
10	GE	900	KG, TEFC
10	GE	1200	XP-Brake
10	L-A	1200	OGA (7)‡
10†	GE	1500	K 284
7½	GE	720	K 326
7½	GE	900	K, TEFC
7½	GE	1200	KG 324‡
7½	GE	1800	K 284
5	GE	720	KT 302
5†	GE	750	K 324
5	GE	900	MTC 5044*
5	L-A	900	OGX324(9)‡
5	GE	1200	K 284, spl
5	L-A	1200	OGX 284
5	GE	1800	K 324
5	GE	3600	TEFC-XP
3	GE	1200	K 254 (3)
3†	Master	1500	TEFC
3	GE	1800	TEFC

* slip-ring ** synchronous † 25 cy. ‡ New

WRITE, WIRE, OR PHONE YOUR REQUIREMENTS
THIS IS A PARTIAL LISTING • WE PAY CASH FOR YOUR SURPLUS

PREFERRED *Electric Motors Inc.*

230 HUDSON AVE., P.O. BOX 767 • ROCHESTER 3, NEW YORK

TURBO-GENERATORS

250 KW, 300 KW A.C. and D.C.

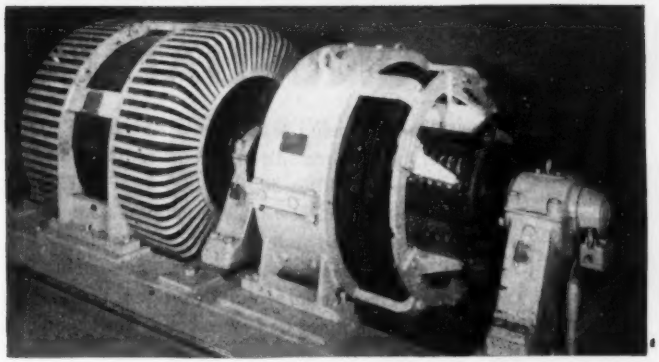
2000 KW 3 phase, 50 cycles, 6300 volts

Immediate delivery

Packed in original crates

Complete Specifications and Details Upon Request

INTERNATIONAL FERMONT MACHINERY CO., INC.
115 BROADWAY
NEW YORK 6, N. Y.



500 K.W. Westinghouse Motor Generator Set

MOTOR GENERATOR SETS
Philadelphia Stock

1—1000 K.W. Westinghouse 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Motor .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels Modern Unit—Can furnish 60 cycle 2300 or 13200 volt.

1—600 KW G.E. MPC—2400 amp. 230 volt 514 RPM with 1050 H.P. G.E.—ATI Syn. Motor .8 P.F. 2 phase, 60 cycle, 2300 volt A.C. & D.C. Panels—Can furnish 3 ph. 550 V. or 2300 V.

2—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/2300/13200 volt, Serial #8130447-48 (year 1935) See actual photo above.

1—500 K.W. Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels—Like New.

1—450 K.W. G.E. Type CY-225 (1941 year) 250 volt 1200 RPM direct connected 650 HP GE-ATI-Syn. Motor 3/60/480 volt. Magnetic Red. Voltage Starter.

3—300 K.W. West. 3 wire 125/250 Volt 1200 RPM Generators (1938 year). Can furnish with suitable motor as single unit or as 600 K.W. 3 Unit Set. Advise Requirement.

1—300 K.W. Elliott 250 Volt 1200 RPM with 500 H.P. Syn. Motor 3/60/2300/1200 RPM—Automatic Controller & D.C. Panel.

2—150 K.W. G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.

1—150 K.W. West. SK 184, 3 wire 125/250 Volt 1200 RPM (1938 yr.) 250 H.P. West. Syn. .8 P.F. 2/60/220 or 3/60/220/440/550/2300 V.

1—100 K.W. Al. Chalmers 250 Volt 1200 RPM 150 H.P. Syn. Motor 2/60 or 3/60 any voltage.

1—100 K.W. G.E.—C.D.—125 Volt D.C. 150 H.P. GE Syn. Motor, 3/60/220/440/1200 RPM.

1—75 K.W. BURKE 250 Volt 900 RPM 113 H.P. Burke—Syn. M.D. 2 phase any voltage.

1—50 KW G.E. DLC—250 Volt 1200 RPM, 75 H.P. Sq. Cg. 3/60/220/440V.

Smaller Sizes and Types—Advise Requirements.

ELECTRIC MOTORS

Q.	H.P.	Make	Type	Volts	Speed
1	1200	Cr. Wh.	Sl. Rg.	2300	257
1	700	G.E.	ATI (syn)	480	1200
2	600	West.	Syn.	440	257
3	500	West.	CS	2300/6600	514
1	400	G.E.	Syn.	2300	450
1	400	West.	CW	440	514
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	250	West.	CS	2300	1200
1	200	West.	Syn.	2300	1200
1	200	West.	MW	440	600
1	150	Ideal	Syn.	220	1200
1	125	West.	CS	440/2300	1800
1	125	West.	Syn. (3 brg.)	550	600
1	125	Cent.	SC	440	1800
1	100	G.E.	K	220/440	1200
1	100	A.C.	Sl. Rg.	440	720
1	100	G.E.	IM	440	600
2	100	G.E.	Syn.	440	300
1	75	West.	CW	440	1200
1	60	West.	CW	440	720
3	50	A.C.	SC	220	900
1	50	West.	CS	440	3600
1	50	West.	CW	220	900
2	50	Cent. (new)	SC	220	1200
1	40	G.E.	MT536	440	900
1	30	G.E.	MT532	440	900
2	25	G.E.	MT332	440	900

DIESEL GENERATORS

1—2500 KVA General Motors, complete plant, 3/60/2300 with 2300 to 230/460 transformers, cooling system, starting equipment, switchboard, can demonstrate on foundations. Immediately available.

1—225 KVA General Motors, Twin 671, 3/60/440. —New 1941.

AIR COMPRESSORS

1—12,000 CFM Ingersoll-Rand Turbo Compressor, 3.25# pressure, 250 HP, 3/60/440/3600 RPM.

1—1050 CFM Ingersoll-Rand ES1, 17¾x13, 50 lb. PSI, 275 RPM, V-belt.

1—880 CFM Worthington Syn. motor drive 150 H.P. 3/60/440/277 RPM, size 17x10¾x12.

2—528 CFM Chicago NSB, 100 lb., 285 RPM V-belt 14x12.

2—368 CFM Ingersoll ER-1, 225 RPM, 100 psi., 50 HP direct gear, M.D. 3/60/220.

1—360 CFM Schramm Vertical V belted on steel base, 75 HP motor 3/60/220

1—277 CFM Chicago PB4 Air Cooled 50 HP V-Belt Motor Drive.

1—254 CFM Chicago Pneumatic NSB-125# Belt Drive 40 H.P.

2—245 CFM Ing. Rand 10x10 ER-1, 125#.

1—215 CFM Penna. 3A 10x8, 50 lb.

2—175 CFM Ingersoll ER-1 9x8, 300 RPM, 100 LB., V-belt.

CENTRIFUGAL PUMPS

Q	GPM	TNH	Description	Size	HP	Speed
2	10,000	200'	LeCourtenay	20"	624	870
2	10,000	100'	LeCourtenay	20"	350	870
1	10,000	114'	De Laval	18"	370	988
1	9,000	88'	De Laval	18"	250	870
2	8,150	132'	LeCourtenay	16"	350	1150
1	8,000	110'	Worthington	14"	500	1200
2	7,000	200'	LeCourtenay	16"	423	1000
2	6,500	100'	Worthington	14"	200	1200
1	6,000	110'	Ingersoll-Rand	12"	500	1200
2	5,000	125'	Worthington	14"	200	1200
1	4,000	110'	Ingersoll-Rand	12"	500	1200
1	3,500	47'	Southwark	12"	75	870
1	3,100	42'	Worthington	12"	50	1150
2	2,550	200'	De Laval	8"	200	1750
1	2,310	24'	Worthington	12"	20	860
2	1,700	96'	De Laval	10"	60	1750
1	1,500	231'	Allis-Chalmers	8"	150	1750
3	1,200	40'	Worthington	6"	15	1750

TURBO GENERATORS

1—750 KVA G.E. Extraction 3/60/2300 volt, 250 PIS, 80 lb. & 16 lb. Extr. Surface Condenser. New 1940.

1—625 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Condensing 180 PSI 35 lb. B.P. New 1936.

1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.

3—300 KW West. 3 wire 125/250 Volt D.C., Non. Cond. Turbo Units 125 PSI, 5 lb. B.P. New 1938—(See Actual Photo.)

1—75 KW G.E. Non-Cond. D.C. 125 volt.

1—35 KW G.E. Non-Cond. D.C. 125 volt.

3—300 KW D.C. TURBOS—125/250 Volt

"Everything from a Pulley to a Powerhouse"

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T.M. REGISTERED U.S. PATENT OFFICE

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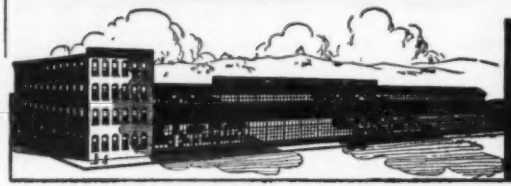
UNUSUAL!!

Running—being tested—at a 45° angle to meet the requirements of an east coast dredging company. This 500 HP, 300 to 600 RPM, 230 volt, direct current Westinghouse motor was rebuilt and redesigned by Glow Electric Company to meet the customer's requirements. Some of the special features were thrust carrying roller bearings and extra heavy fabricated steel base.

You have problems, too, in connection with your electrical equipment. Whether it's locating it, or special applications, may we have the opportunity to help you?



GLOW ELECTRIC CO.
927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

375 KVA - FOR SALE - 300 KW
WORTHINGTON-WESTINGHOUSE
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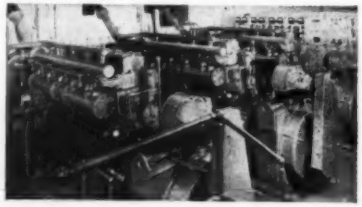

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3 Worthington Model BB 5—150 HP Diesel Engine Generating Units direct connected to Westinghouse Generators.

Rated 100 KW—125 KVA—3 phase, 60 cycle, 460 Volts, AC Current at 600 RPM.

Suitable for reconnection to 85 KW—3/50/230/400 at 500 RPM.

Complete with all accessories and auxiliaries including evaporative coolers—switchboard—distribution panel.

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Single units available

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STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Ebasco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, with Hoppers, Automatic Coal Conveyors, Automatic Ash Conveyor, 36" x 24" Jeffrey Flex-Tooth Coal Crusher.

1—705 HP Stirling 4 dum BOILER with B&W U-type superheater.

1—10,000 KW Allis-Chalmers STEAM TURBINE.

1—7,500 KW Allis-Chalmers STEAM TURBINE.

1—7,500 KW General Electric STEAM TURBINE.

All with complete control equipment.

Send for complete inventory in Denver.

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OIL COOLED
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GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

MARQUETTE GOVERNORS
VARIOUS MODELS: B-117, B-190-D, B-190, B-106, J-90-A, J-90-C, J-90.

DIESEL ENGINES & GENERATING SETS
Various sizes in stock

ALJON ELECTRIC DIESEL CO.
904 Pacific Street Brooklyn 16, N. Y.
STerling 3-6515

220/440 Volt, 60 cycle **SQUIRREL CAGE** open, 3 Phase

GUARANTEED REBUILT

QN.	HP	MAKE	TYPE	BEARING	SPEED
1	200	G.E.	IK	S.B.	900
1	200	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	900
1	150	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	1800
2	125	Kling		S.B.*	1200
1	100	West.	MB	S.B.	1200
1	100	West.	CS	S.B.	720
2	100	G.E.	IK	S.B.	720
1	100	G.E.	KT-347	S.B.	1200
2	100	G.E.	IK	S.B.	900
1	100	G.E.	IK	S.B.	1800†
3	100	G.E.	IK	S.B.	1800
1	100	West.	CS-504	S.B.	1800
1	75	G.E.	IK	S.B.	900
2	75	G.E.	IK	S.B.	720
2	75	West.	CS-725C	S.B.	900
1	75	G.E.	K-505	S.B.	1200
1	75	G.E.	IK	S.B.	900†
2	75	G.E.	IK	S.B.	900
4	75	West.	CS	S.B.	1200
4	75	G.E.	IK	S.B.	1200
2	75	F.M.	QS-443	S.B.	1800

QN.	HP	MAKE	TYPE	BEARING	SPEED
2	75	G.E.	IK	S.B.	1200
1	60	G.E.	KT-346	S.B.	900
1	60	G.E.	IK	S.B.	1800
1	60	F.M.	QS-444	S.B.	1800
1	60	G.E.	KT-333	S.B.	1800
4	60	G.E.	IK	S.B.	1800
1	50	G.E.	IK	S.B.	600
3	50	West.	CS	S.B.	900
1	50	G.E.	KT-342	S.B.	900
1	50	G.E.	KT-342	S.B.	900†
2	50	West.	CS-445	S.B.	1200
1	50	G.E.	KT-327	S.B.	1800
2	50	G.E.	IK	S.B.	1800†
3	50	G.E.	IK	S.B.	1800
1	40	G.E.	KT-542	S.B.	720
1	40	F.M.	BH12D	S.B.	900
1	40	G.E.	KT-330	S.B.	900
1	40	West.	CS	S.B.	1200
2	40	G.E.	IK	S.B.	1800†
2	40	G.E.	IK	S.B.	1800
1	35	G.E.	IK	S.B.	720
1	35	Triumph	B12	S.B.	900
3	30	G.E.	KT-312	S.B.	1800

QN.	HP	MAKE	TYPE	BEARING	SPEED
3	30	G.E.	IK	S.B.	1800
5	30	West.	K-365	S.B.*	3600
1	25	G.E.	IK	S.B.	720
1	25	F.M.	B12P	S.B.	720
1	25	Century	SC-30	S.B.	1200
1	25	F.M.	BH12A	S.B.	1200
1	25	Ideal	A 18	S.B.	1200
1	25	West.	CS-471	S.B.	1800
1	20	F.M.	KBV	S.B.	1200
1	20	G.E.	KT-322	S.B.	1200
1	20	G.E.	KT-312	S.B.	1200
1	20	G.E.	K-364	S.B.	1800
1	20	West.	CS-364	S.B.	1800
2	20	G.E.	K-326	S.B.	3600
4	20	Line-Weld	Frame 326	S.B.	3600
2	15	West.	CS	S.B.	720
1	15	Wagner	15 T	S.B.	1200
1	15	Ideal	A	S.B.	1200
1	15	G.E.	KT-502	S.B.	1200
1	15	G.E.	KT-752	S.B.	1200
1	10	G.E.	IK	S.B.	1200
1	10	G.E.	KT-752	S.B.	1200

* Splash proof † 2200 volt

SLIP RING MOTORS

We offer from stock the following 220/440 volt, 60 cycle, 3 phase, GUARANTEED REBUILT equipment, unless otherwise noted.

QUAN.	H.P.	MAKE	TYPE	SPEED	DESCRIPTION
1	15	G.E.	MT 512	900	S.B.
1	30	G.E.	MT 332	900	
1	30	Al. Ch.	ANY	600	
2	40	Al. Ch.	ARY 444	1800	splash proof, S.B.
1	40	G.E.	MT 336	900	S.B.
1	60	G.E.	I-M	900	S.B.
2	60	G.E.	MT 556	600	
1	60	G.E.	MT 346	900	
1	60	G.E.	I-M	900	
1	60	West.	CW 505	1200	
1	75	G.E.	I-M	720	
1	100	G.E.	I-M	720	
1	100	G.E.	I-M	900	
1	125	G.E.	I-M	720	
1	150	G.E.	I-M	600	
1	150	G.E.	I-M	1800	2300 volt
1	200	G.E.	I-M	600	

TOTALLY ENCLOSED MOTORS

FAN COOLED, BALL BEARING, 220/440 volt, 60 cycle, 3 phase, GUARANTEED REBUILT, unless otherwise noted.

QUAN.	H.P.	MAKE	MAKE	SPEED	DESCRIPTION
1	7½	G.E.	KF 284	1800	
1	7½	Reliance	AA 324	1200	XP, NEW
3	10	L.A.	JS 326	1200	
1	15	West.	CS 328	1800	XP, NEW
1	25	L.A.	JS 364	1800	XP, NEW
1	40	G.E.	K 405	1800	
1	50	Master	FB 404	3600	XP, NEW
1	50	Al. Ch.	ARZZ 444	1800	NEW
1	75	G.E.	K 505	1200	

POWER EQUIPMENT COMPANY

8 CAIRN STREET — P. O. BOX 534 — ROCHESTER 2, N. Y.

Telephone: Genesee 5629

BOILERS

3— 10 H.P. 15# pr.
1—100 H.P. 150# pr.
1—200 H.P. 150# pr.

FACTORY NEW PACKAGE TYPE

STEAM GENERATORS

IMMEDIATE DELIVERY!

from our N. Y. C. Whse.
ASME & Nat. Brd.
Ask for Bulletin "B" & Specs.

FOLLOWING GOOD USED BOILERS
from our used Dept.

1— 10 HP—Cyclotherm Package, 150#
1— 30 HP—Cyclotherm Package, 150#
1— 50 HP—Cleaver Brooks Package, 125#
1— 80 HP—Cyclotherm Package, 125#
1—150 HP—Far. & Tr. Firebox type, 150#
1—250 HP—Titusville Scotch, 150#
1—300 HP—Titusville 3-drum, lowhead 200#

SPECIAL VALUE AND PRICE!

1—20,000# steam/hr. ERIE CITY 3-drum, low head Water Tube; 160# pr. LIKE NEW: INSTALLED 1948—USED LESS THAN 3 MOS. Incl. Peabody Oil Burners w/pre-heaters; Soot Blowers; Condensate Pump; Blowers; Piping; Gauges; Feed Pump; Sup. Steel and Stack. Offering less than ½ replacement cost. Located Bklyn.

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507 5th Ave., N. Y. C. MU 7-6547

Make a friendly connection, Call Sandman for stock deliveries. Partial Inventory of Rebuilt Guaranteed 3-60-220 & 440 V motors.

SQUIRREL CAGE

HP	RPM	Make	Remarks
100	720	G.E.	I-K
40	1800	Al-Ch	20G
35	1200	G.E.	I-K
30	3600	F-M	BB
30	1200	C-W	BAH-405 BB
30	600	G.E.	I-K
25	1800	G.E.	KT-312
25	1200	Cent.	8C30
25	1200	West.	CS
20	3600	G.E.	KT203
20	1800	G.E.	FT501
20	1200	G.E.	KT512 BB
20	1200	G.E.	I-K 2 Shaft
20	800	Wagner	15VRP
20(4)	900	G.E.	FT 536 TEBB
15	1200	G.E.	KT502 BB
15	900	B & M	L-640
15	514	G.E.	KT752
10	1200	G.E.	I-K

WOUND ROTOR

HP	RPM	Make	Remarks
50	900	G.E.	I-M
40	720	G.E.	MR-504 Hoist
25	900	West.	CI572A Hoist
15	1200	Wagner	15VR6
7½	1200	West.	CW452
7½(2)	900	G.E.	MT958
5	1200	Watson	KH7V
5(2)	900	G.E. & West.	MT & CW
3	1200	Cleve.	MBW2375
3	900	G.E.	MT944
2(2)	1200	G.E. & West.	MT & CW
2	1200	Watson	KH5V
1½(4)	1200	G.E.	MT & CW

Also some 550 V & 2200 V ratings.
Largest New Motor Inventory in New England.

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New England's Leading Electric Motor Distributor

SELLING FOR CUSTOMERS

1—375 KVA—240/3/60 Westinghouse geared non condensing turbine.
2—375 KVA—240 & 480/3/60 Cat. diesel sets.
1—50 KW—220 AC & 250 DC West. M.G. Set.
1—1000 HP—270 lb. Springfield boiler.
What do you need—what have you to sell—We have nationwide outlets to help you when buying or selling equipment.
H. BLANE JOHNSON & ASSOCIATES
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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

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7x7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP. 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

MOTORS

250 HP Gen. Electric Synchronous Type ATI 3/25 cycle/2200/500 RPM.

350 HP Westinghouse Slipring Type CW, 3/25 cycle/2200/500 RPM.

400 HP Westinghouse, Synchronous 3/60/2300/900 RPM.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy., 2400/4160 pri., 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

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SPECIAL OFFERINGS

TURBO-GENERATORS

2—4000 KW, 2300 V., 150# Cond.
1—3500 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
2—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 250# Cond.
1—1000 KW, 4150 V., 200# N.C.
2—1000 KW, 480 V., 150# Cond.
1—1000 KW, 480 V., 150# Cond.
1—750 KW, 550 V., 170# Extr.
1—750 KW, 2300 V., 175# Extr.
1—500 KW, 2300 V., 170# Extr.
1—300 KW, 2300 V., 150# Cond.
1—300 KW, 2300 V., 200# N.C.
1—150 KW, 2400 V., 150# N.C.

ENGINE GENERATORS

1—600 KW, 2300 V., Unif.
1—500 KW, 250 V., D.C., Unif.
3—375 KVA, 550 V., Unif.
1—312 KVA, 440 V., Unif.

REFRIGERATION UNITS

3—300 ton motor or turbine driven

BOILERS

2—50,000#, 300#
1—30,000#, 425#
1—35,000#, 150#
3— 500 HP, 200#
3— 500 HP, 400#
1— 438 HP, 200#
2— 400 HP, 150#
4— 150 HP, 150# Sc. Mr.

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

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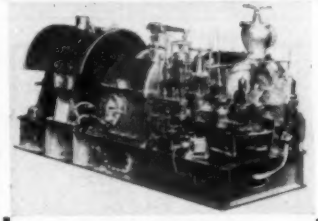
TURBO GENERATORS
USED — GOOD CONDITION



GE 200 KW 120V
ALSO AVAILABLE:
132 KW, 200 KW, 500 KW, 3/60/450 AC

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1500 HP DC MOTORS WESTINGHOUSE

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1200 KW DC GENERATORS —ALLIS CHALMERS

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(Los Angeles Harbor), Calif.
Phone Los Angeles: Nevada 6-2517

COMPRESSOR: Worthington 2 stage, 29/18-½x 21, 600 H.P. synchronous motor, 3 phase, 60 cycle, 440 volts, 180 RPM, 100 lbs. pressure, 3000 CFM, complete with auxiliary equipment. In operation now, available immediately.

DIESEL MOTOR: 122 H.P. Caterpillar D13000 complete with clutch, V-belt pulley, and spare parts.

DRAG SCRAPERS, CRESCENT BUCKETS: 1—Sauerman 2 yd. Drag Scraper outfit complete, without 75 H.P. motor. 1—Sauerman ¾ yd. capacity complete with 30 H.P. motor. 1—Sauerman 1 yd. capacity complete with diesel motor.

BOILERS: 1—Erie City 150 H.P., ASME, return H.P., 160 lbs. pressure, National Board, 3 sure, pin hole grates and all fittings. 2—220 H.P., 160 lbs. pressure, National Board, 3 drum, low head, complete.

A. J. O'NEILL
Lansdowne, Pa.
Phila. Ph.: Madison 3-8300—3-8301

John H. Benson Roy L. Wilimzig

MOTORS!! PUMPS!!

5—250 HP, 1170 RPM, Allis-Chalmers, Splash-Proof, Frame 630—DSWW, 3/60/2300.

1—150 HP, 277 RPM, GE, Synchronous Motor, 3/60/2300, complete with Exciter, Starting Equipment and Magnetic Clutch

1—1000 KVA—AC Generator Westinghouse, 3/60/2300 V. 720 RPM

1—1000 KVA Synchronous Condenser, 3/60/2300/4000 600 RPM

2—24x24 Dayton Dowd CS24, 16,500 GPM 18.5 FT. HD. 360/450 RPM.

1000 other motors in stock!

Phone, Write or Wire!

BENSON-WILIMZIG, INC.
formerly C & S Machinery Co.
1708 N. 8th St. St. Louis, Mo.
GA-4290

TURBO GENERATORS

25,000 KVA G.E. condensing, 200 lbs., 530° FTT, 13,200 volts.

15,625 KVA G.E. condensing, 250 lbs., 500° FTT, 13,200 volts.

12,500 KVA Allis condensing, 225 lbs., 550° FTT, 13,200 volts.

6,250 KVA Allis condensing, 200 lbs., 500° FTT, 2300/4000 volts.

5,000 G.E. non-condensing extraction, 600 lbs., 750° FTT, 125/150 lbs. extraction, 0-50 lbs. exhaust, 13,800/4000 volts.

3,750 KVA G.E. condensing, 150-250 lbs., 500° FTT, 2300/600 volts.

2,500 KVA G.E. condensing extraction, 200 lbs., 550° FTT, 20 lbs. extraction, 480 volts.

1,875 KVA G.E. condensing, 150-250 lbs., 650° FTT, 2300 volts.

1,250 KVA G.E. condensing, 200-400 lbs., 650° FTT, 2300/4150 volts.

1,250 KVA G.E. condensing extraction, 175-400 lbs., 700° FTT, 0-10 lbs. extraction, 2300 volts.

1,250 KVA Westg. condensing extraction, 150-250 lbs., 600° FTT, 5-25 lbs. extraction, 480 volts.

625 KVA Westg. non-condensing, 150-200 lbs. 600° FTT, 5-25 lbs. exhaust, 480 volts.

375 KVA Ridgway non-condensing, 150 lbs., 450° FTT, 0-15 lbs. exhaust, 240/480 volts.

UNIFLOW UNITS

750 KVA Amos-Allis Chalmers vertical, 150 lbs. steam, 5 lbs. exhaust, 2400/4160 volts.

625 KVA Skinner-G.E., 150 lbs. steam, 5 lbs. exhaust, 240 volts.

375 KVA (2) Elliott, 150 lbs. steam, 2 lbs. exhaust, 2300 volts.

312 KVA Skinner-G.E., 150 lbs. steam, 3 lbs. exhaust, 480 volts.

250 KVA (2) Skinner-G.E., 150 lbs. steam, 5 lbs. exhaust, 2300 volts.

CORLISS UNITS

500 KVA Chuse, 150 lbs. steam, 10 lbs. exhaust, 480 volts.

312 KVA Allis Chalmers, 150 lbs. steam, 3 lbs. exhaust, 2300 volts.

BOILERS

1,000 HP Springfield, 120,000 lbs. per Hr., 300 lbs. steam, 600° FTT, stoker fired.

825 HP C.E., 275 lbs. steam, 525° FTT, pulverized fuel.

720 HP (2) C.E. 60,000 lbs. per Hr., 450 lbs. steam, 600° FTT, stoker fired.

540 HP Keeler, 250 lbs. steam, pulverized fuel or oil fired.

350 HP (2) Wickes, 350 lbs. steam, 600° FTT, oil and gas fired.

300 HP (2) Keeler, 10,000 lbs. per Hr., 250 lbs. steam, 500° FTT, stoker fired.

150 HP (3) Bros HRT, 125 lbs. steam, stoker fired.

DIESEL GENERATORS

1,675 KVA Fairbanks-Morse, 2400/600/480 volts, 300 RPM.

1,388 KVA McIntosh-Seymour, 2300 volts, 300 RPM.

900 KVA Fairbanks-Morse, 2400 volts, 257 RPM.

782 KVA Worthington, 480 volts, 327 RPM

546 KVA Worthington, 480 volts, 327 RPM.

312 KVA Superior, 480 volts, 360 RPM.

SPECIAL

1675 KVA Fairbanks-Morse generator, 3 phase 60 cycle 2400/600/480 volts, 300 RPM direct connected to 1750 HP F-M diesel engine, 2 cycle, 10 cylinder, Model 33E16, 300 RPM.
Complete with direct connected exciter, switchgear, and all auxiliaries as in operation. New 1942, excellent condition. Engine can be adapted for dual fuel operation.

RECTIFIER

1,000 KW G.E. Mercury Arc Rectifier, 600 volts DC, 60 cycle, 13,200 volts AC.

HIGH FREQUENCY GENERATORS

2,860 KVA (3) New G.E. AC generators, Type ATB, 3 phase, 120/240 cycles, 4150 volts, 4800 RPM

FREQUENCY CHANGER

3,750 KVA G.E. generator, 3 phase, 60 cycle, 2300/4000 volts, direct connected to 4200 HP G.E. synchronous motor, 3 phase, 25 cycle, 440/22,000 volts, 300 RPM.

INTERNATIONAL POWER MACHINERY CO.

1609 UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO

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3—150 K.W. DIESEL GENERATOR SETS

Buckeye—600 r.p.m.—medium speed Westinghouse generator — 440/3/60 — complete with modern dead front switch gear. Units equal to new—used only 50 hours.

IMMEDIATE DELIVERY

Write—Wire—Phone

THE BOSTON METALS CO.

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LE 1900 **CU 5050**

DIESEL POWER PLANTS

50 KW TO 1250 KW

Remanufactured—Guaranteed! Immediate Delivery!

GM 8-268A Propulsion Engine with reduction gear
GM 3-268A 100 KW AC or DC with Switchboard
GM 8-268A 200 KW AC with Switchboard
GM 12-567A 900 H. P. Marine Propulsion Complete with accessories
GM 16-278A 1600 H. P. Marine Propulsion
Superior GDB-8 150 H. P. 100 KW D.C. 3 wire with or without Generator

Also Diesel Parts

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COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

IMMEDIATE DELIVERY—2-ea. 60,000# hr. capacity 4-Drum Stirling type, 250# psi, (10,000 sq. ft. H.S.) 525° F.TT Boilers. Condition excellent, suitable any fuel, now oil fired.
1—48,000# hr. capacity Boiler, otherwise same as 60,000# (8,530 sq. ft. H.S.) above boilers.

We have many other boilers in sizes of 250 to 600 HP, 200 to 450# pressure.

Turbo-Generators, Condensing, 300 to 10,000 KW.
Turbo Generators, Non-Condensing, 200 to 2500 KW.

Frequency Changers—Motor-Generators & Diesel-Generators

TRANSFORMERS! Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed.

Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK **30 CHURCH ST.** **NEW YORK 7, N. Y.**

MOTORS — M.G. SETS — TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1	400	G.E.	IK	2200	514
1	400	G.E.	KT-412	2300	435
2	300	Whse.	CS-890	2300	1780
1	200	Whse.	CS-873C	2200	1160
1	200	Al.Ch.	AR	440/220	580
2	125	Al.Ch.	AR	2200	1750
1	125	Whse.	CS-761C	440/220	1750
1	125	C.W.	128-Q	440/220	430
2	100	Whse.	CS-663C	440/220	1750
1	100	G.E.	IK	440/220	1800
1	100	Al.Ch.	AR	2200	1160
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H241B	440/220	435
1	100	Whse.	CS-938	2200	495
1	78	G.E.	I-K15	440/220	570
1	75	Al.Ch.	AR	2200	1765
1	75	Al.Ch.	AR	2200	1750
1	75	Al.Ch.	AR	2200	690
1	50	G.E.	KT	440/220	1160

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	PF	Volts	RPM
1	3000	Whse.	80	4800/2400	720
1	700	G.E.	80	2300	720
1	600	Whse.	80	2400	720
1	400	Whse.	80	440	600
1	300	Whse.	80	440	514
1	150	G.E.	100	2200	900
1	150	G.E.	100	550/2200	600
1	150	G.E.	80	440/2200	450
2	125	El.Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900
2	100	Whse.	80	440/220	1800
1	100	Whse.	100	2200	1200
1	100	Ideal	80	220/440	900
2	100	G.E.	80	220/440	600

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1**	3000	G.E.	MT	2200	298
1**	1200	C.W.	SR	2200	237
2**	1000	Al.Ch.	ANY	2 200	235
1**	600	G.E.	MT-20	2200	360
1	500	Whse.	C.W.	4600/2300	514
1	500	Al.Ch.	ANY	4000/2300	514
1**	400	Al.Ch.	ANY	2200	514
2	500	G.E.	I-16-M	2300	450
2	400	G.E.	MT-412	2200	450
1	300	G.E.	I-15-M	2200	1200
1	300	Al.Ch.	ANY	2200	514
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	585
1	150	G.E.	I-13-M	2200	1750
1**	125	Whse.	CW-870	2200	870
1	100	F.M.	H20C	440/220	900
1	75	G.E.	IM	440/220	695
1	75	Whse.	CW-7540	440/220	690

**Mill type pedestal bearing. ***3 bearing.

MOTOR GENERATOR SETS

Qu	KW	Make	RPM	Volts DC	Volts AC
1	2400 3U	Al.Ch.	720	525	4800/2400
1	1500	Whse.	514	250	4600/2300
2	1000	G.E.	514	875	4000/2300
1	500 3U	Whse.	1200	120/240	2300/440
2	500	C.W.	720	575	4000/2300
1	500	C.W.	720	250/275	4000/2300
1	500	C.W.	720	250/275	2300/440
1	200	Ridgway	900	250	2300
1	155	G.E.	720	250	2300/440
1	150	G.E.	1200	500	2300/440
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	2300/440
1	75	Star	1200	220	440/220
1	75	Al.Ch.	900	240	2300
1	50	Burke	1800	240	440/220
1	30	Reliance	1800	250	440/220
1	25	Whse.	1200	120/240	440/220
1	20	Reliance	1800	250	440/220

(3U—3-unit set.)

TRANSFORMERS (Power)

Qu	KVA	Make	Type	Phase	Voltage
1	7500	G.E.	H	3	33000/29700-13800/12600
2	1500‡	Gregory	(X)	3	4160-480
3	250	Packard	OISC	1	13200-2200
8	130	G.E.	H	1	19000/9500-550/2200
3	100	Whse.	SB	1	12075/10955-230/460
3		G.E.	HT	1	33000/2400
3	50	Al.Ch.	OISC	1	22000-220
2	50	Wagner	HE	1	13200/11880-575/287
3	50	Penna	OISC	1	2400/4160-Y-120/240

(X) New, selfcontained, indoor type, air cooled.

DIRECT CURRENT MOTORS

Qu	HP	Make	Type	RPM
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1500	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	350	G.E.	CD-189	1150
1	325	Whse.	QM-660.6	450/900
1	200/250	El.Dy.	422	400/1200
1***	200	G.E.	MPC	500/1200
1	200	Whse.	Mill	300/1200
1	300	Whse.		240/300
1	180	G.E.	MPC	400
2*	150	C.W.	83-H	890
1***	125	Whse.	BK-190	600
1	100/125	Rel.	1995-F	300/1200
2	100	Rel.	1050-T	400/1200
1	90/160	G.E.	MPC	625/1125
1*	50/75	Rel.	1995-F	300/1200
1	35	G.E.	RF-14	500/1500
1	35	G.E.	CD-125	400/1200
1	35	G.E.	CD-147	300/1200
1	35	Rel.	35P	250/1000
1	32½	Whse.	SK-150	400/1200
1*	30/75	Whse.	SK-151L	400/1200
1	30	Al.Ch.	E-145	400/1200
1	30	G.E.	CDM-105	875/1750
2	27½	El.Dy.	153	450/1350
1	25	G.E.	RF-13	400/1600
1	25	G.E.	CD-123	400/1200
1	25	Whse.	SK-140	400/1200
1	25	Whse.	SK-111L	250/1000
2	20	Al.Ch.	E-130	400/1200
3	20	G.E.	CD-123	300/1200

All above 230-VDC except where marked ***.
*** Pedestal bearing mill design 525/600-VDC.
(Rev.) Designed for mill reversing service.
* T.E.F.C

T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

SQUIRREL CAGE MOTORS
1—350 HP C.W. 3/60/2300V/3550 RPM #1196851

SLIP RING MOTORS
1—50 HP WEST. CW 3/60/220V/1175 RPM #2249566
1—500 HP G.E. 3/60/2300V/900 RPM #5275932

SYNCHRONOUS MOTORS w/CONTROLLERS
4—125 HP EL. MACH. 3/60/4800V/900 RPM
24—135 HP G.E. 3/60/4000V/1200 RPM T59632

MULTI-ARC WELDING M-G SETS
24—G.E. 1500 Amp. Synchronous driven (can be rewound for 100 KW DC 240 Volt Output)—w/AC & DC Panels

DIESEL ENGINES — GENERATORS — TURBINE GENERATORS
4—New Hercules DWXD w/Heat Exchangers & Clutch
2—250 KVA Elliot 3/60/208V/1200 RPM Equal to Unused
1—M-G Set 2-4 Brg. B.B. AC 3/60/220-440V/1200 RPM—100 KW DC 240 V.

ALBERT HELLER CO.
210 Snediker Ave. Brooklyn 7, N. Y.

TRANSFORMERS

SINGLE PHASE—60 CYCLES (unless otherwise stated)

QTY.	KVA	MAKE	TYPE & FORM	PRIM. VOLTS	SEC. VOLTS
3	1250	GE	H—VDDJ	13800	575/600
2	750	GE (3 PH)	HT—DH	4150Y	208Y/416
3	333	PITTS.	ODSC	33000	2300
1	250	GE (3 PH)	HT—R	460	218Y/125
3	200	GE	H—KDD	2400	120/240
3	200	PITTS.	ODSC	2300	575
4	200	PITTS.		4150	460
2	200	WEST.	S	2400/4160	600
3	200	MOLONEY		600	220/110
1	150	GE	H—KF	2400/4160Y	240/480
1	150	PITTS.	ODSC	13200	2300
4	100	PITTS.		2100	110/220
2	100	WAGNER	HE	3980	115/230
3	75	GE	H—K	2200	244/488
2	50	WEST.	SK	22000	2300

MANY OTHERS IN STOCK—YOUR INQUIRIES WILL RECEIVE OUR PROMPT ATTENTION
EMPIRE ELECTRIC COMPANY, INC., 87 Jay Street, Brooklyn 1, N. Y.—MAin 4-5900

FOR SALE
COMPLETE 1620 K.W. DIESEL GENERATOR POWER PLANT

Three 800 H.P. Price-Rathbun 4-cycle diesel engines connected directly to three 540 K.W. General Electric generators. With exciters, control panels, and auxiliary equipment. Still on foundations. Available for immediate shipment from Empire, Nevada. For further information and inspection contact E. J. Emery, Purchasing Dept.

U. S. GYPSUM CO.
300 W. Adams St., Chicago 6, Ill.

1—Edge Moor 1000 H.P. Longitudinal drum water tube boiler 200# pressure, complete with all regular fittings. Foster wheeler 125° Internal Superheater. Last Operated in 1949.

Last inspected in April 1950, and approved for operation under Penna. State Laws for Pressure Vessels.

American Engineering Co. Type AA-6 11 retort Taylor Mechanical Stoker. American Blower Corp. 7" x 7" type A vertical slide valve Steam Engine. B. F. Sturtevant Co. type M fuel economizer and 66" Multivane forced draft fan. Also size 10 design 3 multivane induced draft fan. Complete details on request. To be sold as is, where is.

FS-1629, POWER
330 West 42nd Street
New York, N. Y.

WATER TUBE BOILERS

- 408 HP, 200# WP, Cross Drum Water Tube, with all equipment. Hydrostatic test applied, Hartford inspected.
- 360 HP, 350# WP, Cross Drum Water Tube, sectional header, integral furnace. PERFECT CONDITION.

LARGE STOCK — ADVISE REQUIREMENTS
FIREBOX — HRT — VERTICAL

UNITED STEEL PROD. CO.
Box 4111 Memphis, Tenn.

B & W PULVERIZERS

3—Type E-32 practically new Coal Pulverizers, complete with 75 H.P. motors, blowers and all equipment. Used approx. 2 years. Purchased new 1943.

DALTON SUPPLY CO.
2829 Cedar St., Phila. 34, Pa. GArfield 8-1800

This Seal JLHC ...tells you what you buy is GOOD EQUIPMENT!

GUARANTEED GOOD BECAUSE REBUILT AND TESTED UNDER SUPERVISION OF

HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1500	GE	Pyranol	3	4150x2200V
1	500	Kuhl.	OISC	1	4600x2300V
2	400	GE	H	1	6900x3250V
1	800	Pitts.	ODSC	1	7800x440V
3	200	GE	H	1	13,800 pr. 220/460 sec.
1	200	GE	HT	2	2300x220
1	250	Whse.	Auto	3/3	4150x2300
1	500	Pitts.	OISC	1	4000x110/220
1	200	GE	Auto	3/2	4150x2400
1	150	GE	HT	3	4150-120/208Y new
1	150	GE	KS	1	2300x230
1	100	Pitts.		1	2750x110/220
3	100	Wagner	RCKV	1	240x120/120
2	100	Whse.	SK	1	4400x220/440 Taps
3	75	Whse.		1	2400-240/480
2	50	Whse.	Interleen	1	2400x120/240

SPECIAL—WELDING MOTOR GENERATOR SET

1—176 KVA Whse. Welding Gen. Set, 1 Ph. 220V, 800 Amp 67% PF with Slip Ring Motor & Exciter

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED DC		AC
1	1000	GE	514	600	2300/4150 Syn.
1	300	GE	1200	250	2300 Syn.
2	200	Whse.	900	250	220/440 Syn.
1	150	GE	1200	125/250	
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	Al. Ch.	900	125/250	220/440 S.C.
1	100	CW	1200	125	220/440 SC
1	100	El. Mach.	1200	125	4150 Syn.
3	94	GE	1200	60	440 SC
2	40	El.Mach.	1750	125	440 SC

SYNCHRONOUS

300 HP El. Mach. 720 RPM 2300 V T.E.F C. outdoor Service

200/100 HP Whse. 720/360 RPM. 4150 V.

SLIP RING

1	3500	GE	MT	4600	257
1	250	Whse.	CW	440	900
1	200	GE	MT	2300	1800
1	200	Whse.	CW	440	600
1	200	GE	MT	440	600
1	100	GE	TM	440	400
1	75	GE	MT	220	200 Vert
1	75	GE	MT	440	1800
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1730
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1750
1	55	GE	MT	220	600
1	40	GE	MT	220	1200

FOR POWER
J. L. HEMPHILL & CO.
1658 53rd STREET NORTH BERGEN N. J.

Member of The National Industrial Service Association, Inc.

Non Condensing Turbo Generators

2250 KW. 2300 v. 225# 3600 RPM
1000 KW. 2300 v. 150# 10# b.pr.
750 KW 480 v. 150# 15# b.pr.
300 KW. 240 v. 125-150# geared
575 KW Diesel Set, 360 r.p.m. (never used)
750 KW. BLEEDER-COND. 180#-25#

BOILERS

3—35,000# each. Sectional, 450#
1—50,000# Bent Tube, 225# & SH.
2—1000 HP. Sterling, 250# & SH.

? *On what capacity units shall we quote you* ?

The Stephen A. Douglass Co.
630 Ft. Washington Ave., New York 33, N. Y.

BOILERS—TURBINES

1—10,000 KW turbo generator complete with surface condenser.

1—65,000 lbs. per hr. 450 lbs. pressure sectional steel header, 4" straight tube type boiler.

3—600; 2—565; 2—400 HP B&W vertical forged steel sectional header, 200 lbs. pressure water tube boilers.

1—850; 1—1500 cubic ft. motor driven air compressors, 110 lbs.

A full stock of power and distribution transformers, switch gear, including potential and current transformers, circuit breakers etc. at reasonable prices.

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We do our own rigging and dismantling.

HOWE BROTHERS
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ELECTRICAL CABLE

- for every industrial and power application
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

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BOILERS
10 to 5000 H.P.
Diesel, Steam Turbine, Engine
GENERATORS
Heavy Power Equipment
Industrial — Chemical Process Equipment
UNUSED — RECONDITIONED
DEAN G. STRICKLER & ASSOCIATES
1346 Connecticut Avenue, N.W.
Washington 6, D. C. • DuPont 3386

SQUIRREL CAGE MOTORS
3 Phase 60 Cycle

	HP	Make	RPM	Type
1 New	30	L-A	900	TEFC, 220/440, EB
1	60	G.E.	720	IK, 220/440, SB
1	75	Whse.	580	CCL, 220/440, SB
1 New	75	El. Mch.	500	440,BB
1	100	Whse.	720	CCL, 220/440, SB
1	100	Wagner	1200	TEFC, 440, BB
1	100	A-C	1800	Sync. 440, SB
1	40	A-C	1200	Rx. Pr., 220/440, BB
1	50	US	1800	220/440, Hollow Shaft Vert.

SLIP RING MOTORS
3 Phase 60 Cycle

1	30	G.E.	850	MT, 220, SB
2	30	G.E.	850	MT, 2300, SB
1	40	Whse.	850	CW, 220/440, SB
1	50	G.E.	1730	MT, 220, SB, Vert.
1	60	CW	1740	SB, 220, BB, Vert
1	60	G.E.	850	MT, 220/440, SB
1	75	Eng. Ltd.	1200	220/440, BB, 50 Degree
1	125	Whse.	1200	CW, 440/2300, BB
1	150	Whse.	450	HF, 220/440, SB
1	150	Whse.	1200	HF, 2300/4000, SB
1	200	Whse.	600	CW, 220/440, SB
1	250	Whse.	1750	CW, 220/440, SB
4	3000	G.E.	120	TM, 2300, SB
1	400	G.E.	750	TM, 440,25 Cy, SB
1	600	G.E.	740	TM, 440,25 Cy, SB
1	800	G.E.	738	MT, 440, 25 Cy, SB

SPEED REDUCERS

1	350	Whse.	500/1000
1	350	Whse.	1000/300
1	700	Elliott	4500/1200
1 New	320	Jones	900/180

MISCELLANEOUS

1—350 HP, 5000 RPM, Westinghouse, steam turbine. 250# steam, 20# exhaust. With Woodward governor

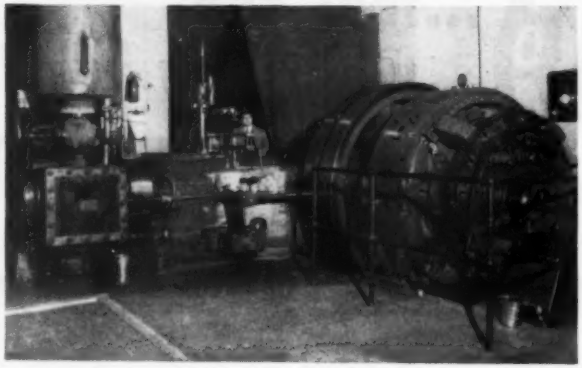
2—12000 CFM, 16 Oz., Allis Chalmers, Turbo Blowers. 3-60-440.

1—300 KVA, 257 RPM, 3-60-440 volt, Fairbanks Morse alternator.

30—Misc. motor pump units, 1 to 15 HP.

WM. KECK'S SONS
Electric Motor & Engineering Service
201 N. Bluff Street **Joliet, Illinois**

ENGINE GENERATOR SET . . .



300 K.W. Crocker Wheeler 250 Volt D.C. Generator, Size 170-DA, Type CCD 200 RPM, 1200 Amp., Direct connected to Skinner 20"x 24" Counter-flow Engine 150 lb. Pressure, Oil-Filter, Water Condenser, New 1938. Dismantled & Ready for Shipment.

Excellent Condition

L. J. HOY - - - - TOLEDO 2, OHIO

122-126 NEBRASKA AVENUE - - - - - - - - - - - ADAMS 1914

FOR SALE

SQUIRREL CAGE

(2) 1000 PN 3/60/2200/1800 New
200 CS 3/60/440/1200
250 KT 3/60/440/1800
250 CS 3/60/2200/1200
100 CS 3/60/440/1800
100 General Electric 1-E. 3/60/440/1800
(2) 100 General Electric 1-E. 3/60/440/1200
(2) 75 CS. 3/60/2200/690
(6) 50 Wagner, 3/60/220/1200
(1) 35 CS. 3/60/1200. Ball Bearing

SLIP RING HOIST

600 Westinghouse C1, 3/60/2200/600
225 Westinghouse C1, 3/60/440/600
75 ITC, 3/60/440/900
112 ITC, 3/60/440/600
35 C1, 3/60/440/900
50 MTC, 3/60/440/900
100 G.E., MR, 3/60/440/690
15 C1, 3/60/440/870
7½ C1, 3/60/440/1200

Many other sizes in continuous rated slip ring, Transformers, Capacitors, Control Equipment, etc.

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829 RICHMONT ST. SCRANTON, PA.

CAPACITOR PLUGS

248 Used Units

GE PYRANOL CAPACITOR ‡16F14
7.5 KVA 230 Volt, 60 Amp, 3 phase

TRUMBULL FLEX-A-PLUG FL322
60 Amp, 250 Volt, 3 pole

Plant Engineer

PACKAGE MACHINERY COMPANY
East Longmeadow, Mass.

MODERN POWER PLANT

2—250 H.P. 200# W.P. 1942 Erie City 3-Drum, low head Watertube Boilers, complete with Pratt-Daniels Stack, each Boiler. Peabody Mechanical Oil Burners, separate Pump Sets, each Boiler, separate Feedwater Heaters, each Boiler, complete Duplex Pump Sets, Feedwater Regulators, Brooks' Controls, Catwalks, Non-return Valves, Steam Bends and Headers, Soot Blowers and Piping. Can be inspected National Fireworks Co., West Hanover, Mass.

2—750 H.P. B&W Stirlings, 200# pressure, 1925, ASME. New Tubes available immediate shipment.

4—750 H.P. Stirlings, 175# 1920 ASME, located at Houston, Texas.

A substantial number of additional Boilers and Firing Equipment in all sizes. See "POWER" ad, August issue.

Telephone MUrray Hill 2-9098

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Detroit Single Retort UniStoker—6' 6" wide by 5' 6" long—35.7 Sq. Ft. active grate area. Applicable to 150 H.P. nominally rated boiler with forced draft fan with capacity for 175% of rating. Equipped with 7½ H.P. motor and spare parts.

Stoker new in 1940 and is in excellent condition. Would cost about $3,000.00 today, will sell for $1,200.00 immediate delivery.

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PHILADELPHIA 44, PA.

625 KW Turbo-Generator, cond., 440 v., 140#. Nordberg—G.E. diesel-elec. generator set, 875 KW. F-Morse diesel-elec. gen., 250 KVA, 2400 v. Cooper Bessemer 1000 HP diesels, rev., new (2). Superior diesel-elec. gens. (3), 100 KW, d.c. Locomotive cranes, 25, 30 tons, diesel, gas (3). American, Clyde, Colby Whirley Gantry Cranes (5). Locomotives, 7 to 65 tons, gas, diesel, steam (5).

H. Y. SMITH CO.

828 N. B'way, Milw. 2, Wis.

Air compressors—Electric and Diesel 800-500-300 cfm. Boilers—low head 3 drum 400 and 300 H.P. 200#. Water heater and softener 1500 h.p. pumps—Steam header piping—trim—HRT boilers 200—100 H.P. 150# stacks—Steel—72" by 200 ft 28" by 70 ft. all sizes. Foamite system complete 80000 tanks —40000 bbl tank. G.E. Exciter 35 K.W. 750 rpm 200 amp—immediate delivery 1000 kw. mercury arc rectifier—rotary converter—M.G. sets.

H. A. Woodworth—611 Olive St., St. Louis Mo. Main 1071

STARTERS

2—WHBE. Slipsyn, Tot. Encl. Magnetic, AutoTrans. UNUSED
600 HP @ .8-700 HP @ 1.PF
NEVER INSTALLED

MERRILL and COMPANY

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Telephone: HArrison 7-8289

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Liquidation Sale—Twin 6—71 General Motors model 12103. Heavy duty reduction gear to 900 R.P.M. With starting batteries and silencers. A standby unit used 4500 hours.

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1500 N. KOSTNER AVE. CHICAGO 51, ILL.

COMPLETE BOILER PLANT

consisting of 200 HP 78x20 HRTs; 150# P., complete with Oil Burners; Water Softener; Feed Water Heater; Pumps; Etc.

3—72x18' Hand or Spreader Stoker

2—150 KW Factory Built M. Gen. Sets

H. & P., 6719 Etzel, St. Louis 14, Mo.

100 KW GENERATOR SET

BUCKEYE DIESEL 400 RPM 3/60/240 with V-Belted exciter, Switchgear, Voltage Regulator, Oil filter, Silencer, Water Pump. Engine overhauled.

Immediate delivery—Priced to Sell

ROBERT L. NEISWANDER

418 S. Pears—Lima, Ohio Tel. 42867

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500	2200	G.E.	450
450	440/220	Whse.	514
400	2200	G.E.	1200
350	2300/440	G.E.	450
300	440	Whse.	3600
250	440/220	Whse.	600
250	2200/550	G.E.	450
250	550/440	G.E.	1200
200	440	G.E.	450
200	440	G.E.	450
184	4000/2300	G.E.	1800
150	440/220	Whse.	600
150	440/220	Whse. (3)	1800
145	4000/2300	G.E.	1800
125	550/440	G.E.	1200
100	440/220	G.E.	600
100 (3)	440/220	Whse.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2300/400	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HB	277
250	440/220	G.E.	ATI	600
250	4000/2300	El. Mchy.	Syn.	600
240	2300/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
150	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator, dir. conn. to 50 hp, G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37000 V., G.E., Type FHKO-236 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
250	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2200/440	G.E.	K	1200
75 (5)	550	G.E.	KF	1800

A. C. GENERATORS

1—320 kva, 600 rpm, 2300/440/220 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—225 kva, 720 rpm, 2300/440 v., G.E.
1—150 kva, 900 rpm, 480/240 v., G.E.
3— 75 kva, 1800 rpm, 480/240 v., Whse.
1— 50 kva, 1200 rpm, 440/220 v., G.E.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G.E.	CD	1150
250	230 (2 new)	Cr. Wh.	CMC	1800
150	230 (2)	Whse.	SK	850
150	230	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	635
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 220/440 v., synchronous
1—75/90 kw, 250 V., 1200 rpm, G.E. conn. to 125 hp, 440/220 V., sq. cage
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/440 v., syn. motor.
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage

TRANSFORMERS 60 CY.

3—333 kva, G.E., 13,200—2300 V.
2—333 kva, G.E., 4600/2300—220/460 V.
2—300 kva, Whse., 12200—440 V.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—250 kva, Whse., 2300—208 V.
3—200 kva, Whse., 13,200—2300 V. (Inerteen)
4—200 kva, Moloney, 2400—230/460 V.
3—150 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
2— 75 kva, G.E., 2400—240/480 V.
6—150 kva, Al. Chal. 2400—240/120 v.
1—150 kva, Whse, SK, 13200-125/215 v., 3 ph.
2— 75 kva, G.E., 480—240/120 v., Pyranol
3— 50 kva, G.E., 480—240/120 V., Pyranol

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

FOR SALE

GENERAL ELECTRIC TURBO-GENERATOR

200 Lbs. condensing, 7500 KW, 3 phase, 60 cycles, 5000 volts.

To be removed during September to make room for larger unit.

Maintenance has been kept up and unit runs in perfect balance. Will carry its full rated load. Generator recently rewound and is fitted with surface air cooler. May be seen in operation at Lone Star Steel Company.

Voltage now stepped up to 7200 through 10,000 KVA, 3 phase auto transformer which is filled with fireproof liquid. Transformer also for sale.

See

LONE STAR STEEL COMPANY

LONE STAR TEXAS

1—Evaporator—G. R. style R bent tube purchased 1937 shell 185 psi, heads and tubes 400 psi, 9000 lb./hr. capacity net. With safety valve and some fittings. Admiralty tubes 188 sq. ft. effective surface.

1—Boiler Feed Pump—Worthington turbine type centrifugal type W-1 Class BF 5 stage 5 inch horizontally split 797 gpm 1110 ft. TDH at .939 specific gravity. 1750 RPM complete with Westinghouse 400 HP —2300 volt—3 phase constant speed induction motor. Falk coupling, bedplate, no controls. Pump purchased 1929 motor 1945.

2—DeLaval Centrifugal Pumps—never used—model 2-IS-3/2A each single suction horizontally split 2 stage rated 50 gpm at 288 ft. head, 1750 RPM, with coupling, on bedplate.

For detailed additional information write to:

J. J. Morse, Purchasing Agent
New Orleans Public Service Inc.
317 Baronne Street
New Orleans 9, Louisiana

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Quantity	Size	Capacity lb/hr	Pressure psig	°F Temp.	Quantity	Size	Capacity lb/hr	Pressure psig	°F Temp.
3*	2" x 3"	30,000	1340	935	3*	4" x 6"	35,000	500	850
1	2" x 6"	50,000	1320	850	1	6" x 12"	80,000	500	470

*One each in original shipping crates. All others listed were used not over 500 hours each.

FS1129 POWER, 520 N. Michigan Ave., Chicago 11, Ill.

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EVAPORATORS or DEMINERALIZERS

COCHRANE PRESENTS SOME INTERESTING DATA FOR THE OPERATORS OF PUBLIC UTILITY BOILER PLANTS

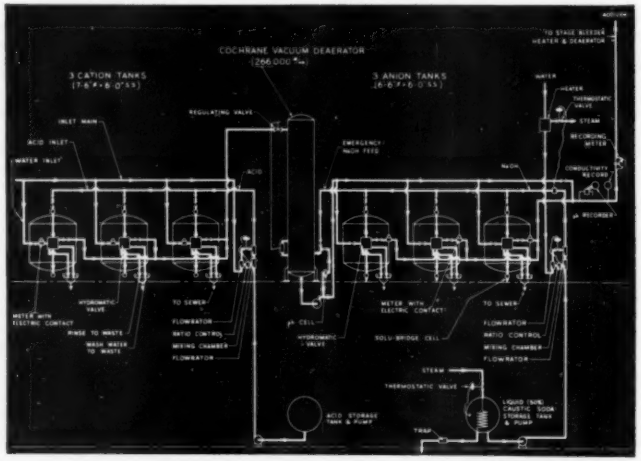
The adoption by a number of central power plants, of Demineralizers for treatment of boiler feedwater in place of evaporators, has aroused great interest on the part of utility operators everywhere. Cochrane Corporation has made a study of the subject and has some interesting facts which will bear examination.

ADVANTAGES OF DEMINERALIZING:

1. **Full makeup supply available continuously.** With evaporators the available capacity varies with the turbine load. Demineralizers can produce full desired makeup capacity irrespective of turbine load.
2. **Greater economy in overall station efficiency** with Demineralizers because no heat is used in producing demineralized water and no loss of power suffered by degradation of steam.
3. **Better quality makeup water.** Demineralized water has higher pH values than distilled water produced from an evaporator with CO_2 present in the vapor. Carry-over problem, common to evaporators, is eliminated. Total solids of actual demineralized water lower than usual actual distilled water.
4. **Lower maintenance costs.** Corrosion in vapor and distillate lines avoided by Demineralizing.
5. **Lower labor costs.** Demineralizers can be made automatic.
6. **Greater flexibility of heat balance.** Frequently the heat balance must be changed due to increasing steam demands on plant. Evaporators interfere with such drastic heat balance changes. Demineralizers permit greatest flexibility.

Write for these papers:

Experiences with Silica Removal Demineralizers.—Paper presented Midwest Power Conference, April, 1951. Evaporation vs. Demineralizing and Silica Removal. A discussion at Engineering Society of Western Penna., October, 1950.



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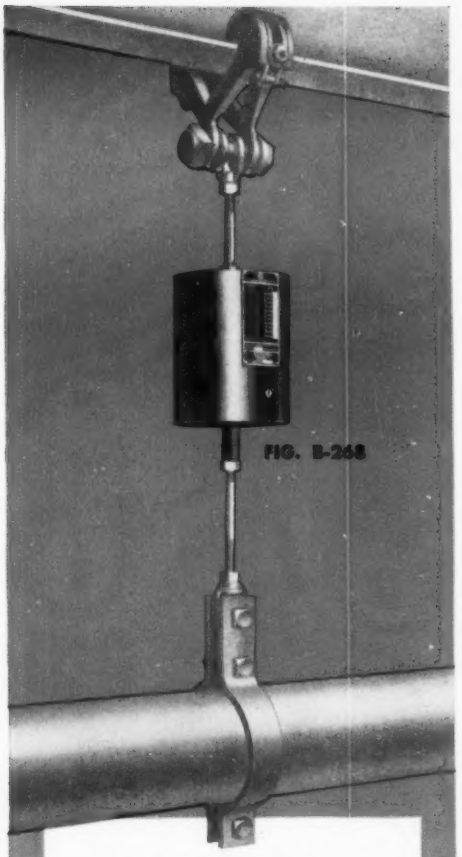

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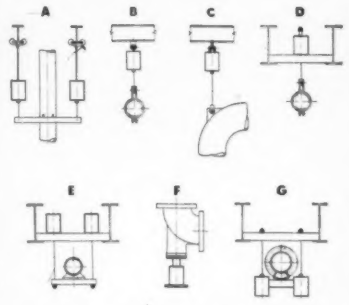
- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range where variation in supporting force is at a minimum.
- Compact—minimum headroom made possible by precompression*.
- Guides prevent contact of coils with casing wall or hanger rod and assure continuous alignment and concentric loading of spring.
- All-steel welded construction meets pressure piping code.
- 16 sizes available from stock — load range from 74 lbs. to 9000 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.
- Unique swivel coupling provides adjustment and eliminates turnbuckle.

*Precompression is a patented feature.

TYPICAL APPLICATIONS

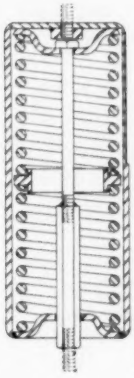


(A) Rod threaded to top cap (B) Furnished with single lug (C) Two lug style (D) Top adjusting (E) Adjustable top and bottom (F) For floor support (G) Trapeze assembly.

FOR LESS VARIATION IN SUPPORTING FORCE — FIG. 98

Fig. 98 is an adaptation of Grinnell's popular spring hanger, Fig. 268. It consists of two springs arranged in series within a single casing. A centering guide insures the permanent alignment of the spring assembly.

Fig. 98 has half the load deflection rate, and double the total working range of Fig. 268. Its 16 spring sizes accommodate loads from 74 lbs. to 9000 lbs. — but with a total working range *up to 5 inches!* Fig. 98 comes in the same seven types as shown for Fig. 268. Design details for identical types and sizes are the same for Fig. 98 and Fig. 268.



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